

Research Memorandum 71-4

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**SIMPO-I DISTRO--DISTRIBUTION
ROTATION MODEL**

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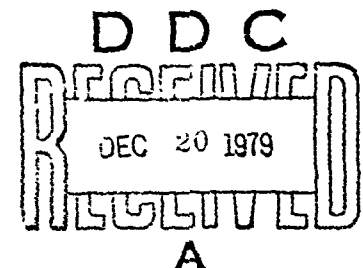
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U. S. Army

Behavior and Systems Research Laboratory

December 1971



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(6) SIMPO-I DISTRO--DISTRIBUTION ROTATION MODEL.

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SUMMARY

The DISTRO model is an adaptation of the SIMPO-I General Matrix Manipulator (GMM). The adaptation was at the direction of a special monitor team from the SIMPO-I Steering Committee, and required by the Program to Improve Management of Army Resources (PRIMAR II).

Based on the GMM, a mass flow model was developed to provide maximum coverage of policy-caused nondeployability. The model depicts the rotation, replacement, skill acquisition, and retention aspects of a 3-character MOS. It uses the results of the monthly projection of a basic personnel inventory by the GMM in a special computerized routine to predict distribution capabilities. Specific tour durations and service commitments, permanent and temporary deployability factors, and delays after training or enroute to assignments are constraints on the availability of individuals for reassignment.

The present Research Memorandum describes the system simulated and the sections of the model logic that differ from the GMM. Instructions for model application, a listing of the DISTRO computer programs for the model, and sample input and output are provided.

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SIMPO I DISTRO -- DISTRIBUTION ROTATION MODEL

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SIMPO I. DISTRO -- Distribution-Rotation Model

REQUIREMENT FOR MODEL

The major objective of the U. S. Army Behavior and Systems Research Laboratory Work Unit, Simulation of Personnel Operations (SIMPO I), has been to develop computerized models with which management can study and evaluate personnel policy changes. With such models management can consider well in advance the effect of proposed policies in relation to hypothetical events which seem likely to happen in the future.

Under the Program to Improve Management of Army Resources^{1/}, the original plan was for Project 5-1, "Developing Techniques for Assessing the Impact of Personnel Policies on Deployability", to develop procedures to assess quantitatively the impact of personnel policies on deployment and readiness. Because the goal of this particular project seemed to be almost identical with the SIMPO I objective, formal establishment of an Army study group to work on the requirement was dropped in favor of shifting responsibility to a special Monitor Team from the SIMPO I Steering Committee.

Work toward the goal of insuring that the Army Staff would have appropriate tools to assess the effect of policy changes (or continuance) upon the number of men available for reassignment to

^{1/} Action Plan for PRIMAR II, McKinsey and Company, Inc. Page 1-16

a selected area progressed as a joint effort of the Monitor Team and the SIMPO I staff, with the latter providing plans and the Monitor Team guidance. The final work plan provided by the SIMPO I staff was reported to the Monitor Team in a summary report listing and describing SIMPO I models. Major portions of this report are to be found in BESRL Technical Research Report 1157, Summary of SIMPO I Model Development.

Along with descriptions of all SIMPO I models actually in use in late 1968, the report gave plans for models scheduled for completion by the end of FY 1969. Of particular relevance to PRIMAR II was the plan to adapt and extend a general model to simulate a personnel system designated by the Monitor Team. The personnel system modeled was selected as being one responsive to deployment-inhibiting policies by Staff Officers of the Capabilities and Analysis Division, Division of Procurement and Distribution, Deputy Chief of Staff for Personnel (ODCSPER-CAD). The planned model, although similar to other mass flow models coming out of SIMPO I, is concerned with more interacting variables affecting deployment than had been modeled previously.

HISTORY OF SIMPO I CONCEPTS OF PERSONNEL ASSIGNMENT

SIMPO I has recognized that for results obtained from simulation models to approach what happens in the real system under the conditions being studied, adequate representation of relevant system characteristics must be made. These characteristics are dependent

upon the rules used by those responsible for operation of the system and for use of the personnel in the system.^{2/} Individual differences among system members must also be considered. Depending upon the urgency of the situation (either real or hypothetical) and the hierarchy of values held by management, some members of a system are less likely than others to be used to fill a given job vacancy. Those more likely to be assigned to overseas stations are said to be more "deployable". Within a given set of rules which fully describe the limits of use of system members for assignment to an area, a dichotomy of "deployable" and "nondeployable" persons can be made from those being considered for such assignment. The model used to predict the status of personnel availability would need to meaningfully relate rules, system variables, and individual characteristics so that only "deployable" persons were used to fill requirements, if its predictions were to be valid.

From the beginning of the SIMPO I effort, BESRL scientists have recognized the need to represent different levels of system

^{2/} SIMPO I models can be compared to the real system with regard to both intermediate and terminal output. Such comparisons can be used either to evaluate the extent regulations are being followed in the system or to determine the adequacy of the model for predicting system outcomes. In other words, a failure of model and system outcomes to agree can be used to pinpoint system failures as well as casting doubt on the validity of the model. Failure to agree may be due to a logical error in the model or to a failure to consider a critical variable. The first kind of error should, for the most part, be completely eliminated prior to validation studies. Comparison with the real system is not required to identify this kind of error.

usefulness for the individuals represented in the models. In the very early bulk flow models, the operating personnel inventory was discounted to make allowance for persons in transient, student, patient, or prisoner status. Later models have had nodes (states) representing stabilized assignments or recent returnees from assignment to combat areas. Some SIMPO I models have monitored time before expected termination of service in order that end-term nondeployability might be represented. Availability indices have been used to approximate the inhibiting effects of miscellaneous categories of nondeployability. Delay between system entry and first assignment has been considered in some models.

The SIMPO I models have become increasingly complex as effort has been made to depict more relevant aspects of the systems being simulated. Very early models represented the personnel system in a steady-state condition with flows between nodes constant across time periods. This was not a bad approximation so long as major shifts in force location or status did not take place. However, the Vietnam involvement brought a heavy buildup of force in that area. The steady-state models could not realistically reflect the changing situation. SIMPO I then turned to dynamic models in which flows between nodes could be different from one time period to the next. The early dynamic models used a vector of numbers at each node in the model. At each update (each move from one time period to another), groups of individuals completing fixed length assignments were shifted, losses were taken, and groups in block $n - 1$ moved into block n of each node. Within the node vector, position

represented time in state in the system, in location, or in grade. By modeling carefully chosen rules for reassignment, and using indices to represent nondeployability, a reasonable abstraction of the real rotation (promotion) system was made.

Different enlistment terms with related variation in reenlistment rates caused SIMPO to move on to a matrix representation of the model nodes. With a matrix it is possible to consider at least two time measurements. Compared to the vector node, the matrix allowed an additional variable to be monitored. The additional time variable was important to modeling the rotation-assignment system, since both time in assignment and time remaining until expected release from the Army need to be considered when reassignments are made. Heavy losses at the end of the first enlistment term can be simulated at the appropriate time in the matrix-node model. This was not possible in the vector-node model.

SIMPO I models which use matrices for at least some of the nodes are ACCMOD, DYROM II, the Career-NONcareer Model, and the General Matrix Manipulator (Figure 1). The models are individually documented in BESRL reports. (See references 1-4 for reports on the models).

The General Matrix Manipulator (GMM) is a set of flexible, compatible subroutines with which a variety of personnel systems and policies can be modeled. The GMM has been designed to allow for the rules of flow between nodes to be furnished at the time of model use, and to allow the number of nodes to vary from one problem to another (Figure 2). The GMM concept grew out of SIMPO I experience with several

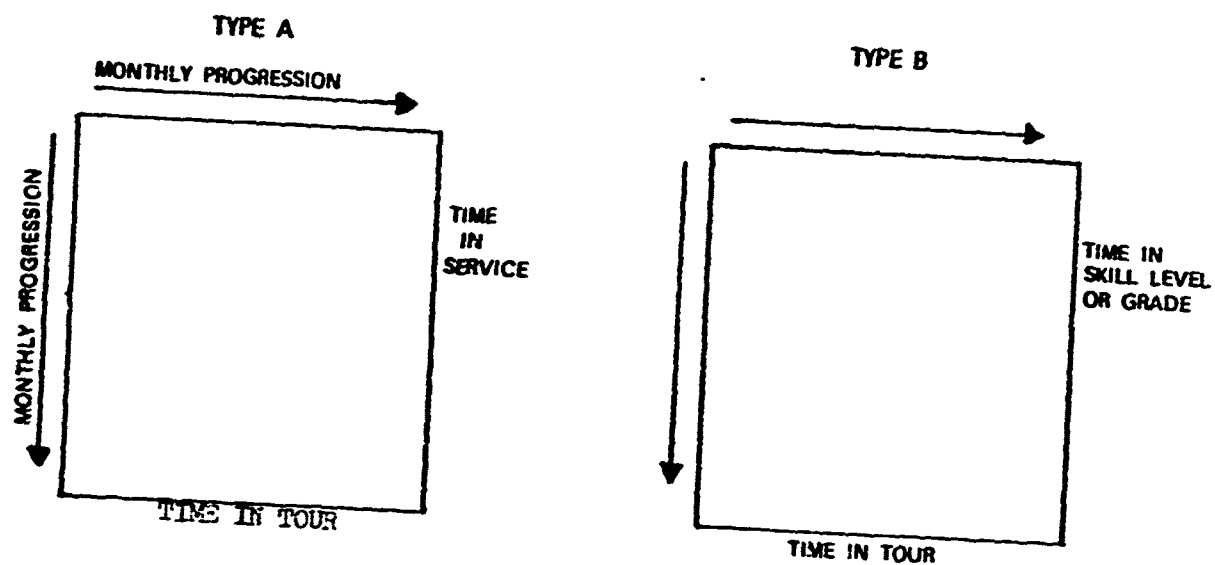


Figure 1. Node types in the GMM.

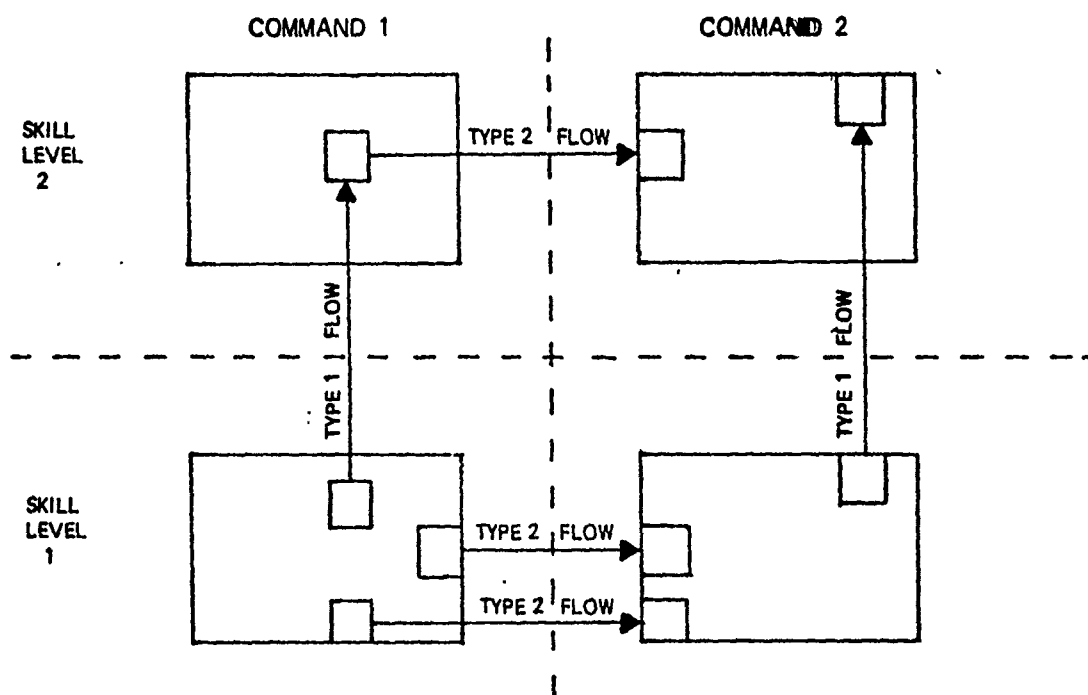


Figure 2. Node Type B flows in the GMM.

specific models which were efficient for a given system and a limited number of personnel policies, but which had to be redesigned for each dissimilar system or each new policy. The GMM stores most system information in secondary areas of the computer (high speed discs). Information on system status is alternately transferred to the primary area where necessary calculations are made and then written onto a new disk when the calculations are completed. Thus, at the loss of speed and efficiency, the size of the system possible in the GMM is dramatically increased over the capacity of the other three matrix-node models.

DESCRIPTION OF THE PROBLEM

Existing policies impose constraints on the Army's ability to meet overseas commitments. New policies being considered by management may result in new restrictions. A data projection system which fails to consider existing policies or which does not provide for consideration of anticipated policies fails to present a realistic picture.

Until a short time ago, distribution capabilities were estimated by Army management on the basis of number of jobs to be filled compared to the total number of men with appropriate skills in the Army. Consideration was not given to such restrictive conditions as recent return from combat assignment or a short period remaining before the end of commitment. Limitations on the usefulness of the early

distribution report were recognized by ODCSPER analysts and the need was expressed for comprehensive model coverage of the many deployment-inhibiting personnel policies in effect.

Distribution of personnel to command elements, one of the five functional areas of Army personnel management, was affected by rotation policy. Many separate policies were involved. Only one year of involuntary service in Vietnam was normally available from a two-year or three-year enlistee. Career service men were allowed to spend two years on family-accompanied assignments for each year spent on unaccompanied assignment. It was too costly of travel and job familiarization training to use a replacement who had only a few months left to serve. Many assignment policies affected only a few individuals each but together affected a significant number. Personnel shortages in a particular grade or skill level were covered by substitutions from the next lower, or sometimes from the second lower level. These and other similar considerations made it desirable to model more than one skill level in the same system and to make provisions to monitor time in tour and time in the system.

Since the GMM monitored two time dimensions in each matrix node and allowed the number of nodes to vary depending upon the systems modeled, plans were made to use the GMM in a distribution-rotation mass-flow model designed to provide maximum coverage of nondeployability.

THE DISTRO MODEL

Although an estimate of distribution capability was needed

on the basis of number of persons available for assignment to each command element - the lowest Army segment directly affected by the central replacement system - a more efficient computer model was achieved by dividing the rotation-assignment system into model nodes on the basis of tour lengths and rotation restrictions. After system flows were simulated between these areas, actual distribution estimates could be made mathematically, considering the priority of elements within the major areas.

Assignment areas represented in DISTRO sample problem were

Twelve-month short tour, ST1.

Thirteen-month short tour, ST2

Long tour, LT

Stabilized CONUS tour, SB

Other CONUS, C

Before overseas, C1

After short tour, C2

After long tour, C3

After CONUS, C4

The Infantry MOS (11B), which was selected for the sample problem, has three skill levels, 11B1, 11B2, and 11B4. Within the two lower skill levels, there are first term individuals under two-year and three-year enlistments. Since representation of end-term nondeployability was required in the model, it was important to provide separate nodes for the different enlistment terms. A total of 40 matrix nodes was required to cover all combinations of assignment area, skill level, and type of enlistment. The

maximum size of any required matrix was 48 by 48, to provide occupants of the CONUS tours at the beginning of the 24-month simulation the possibility of remaining in the same tour the complete simulation period. (The SIMPO I GMM makes all matrices the same size.) See Figure 3 for a tabular display of the nodes. Remember that each node is a 48 by 48 matrix with rows representing months in assignment, and columns representing months in the system. Measurement of time in the system for the career categories in the highest skill level was not a factor under consideration by the DISTRO model. However, the matrix node was required by the GMM concept.

Rotational and assignment flows are shown in Figure 4. In addition to the flows in the figure, DISTRO covers the flow from the lower skill level MOS to the higher and the flow from first to subsequent enlistments. All three types of flow are under control of the priority-of-fill rules input by the analyst. Actual rules used in the DISTRO example are shown later in discussion of the sample problem.

Computer programs for DISTRO are written in FORTRAN for the Control Data 3300³ computer, with 32K memory. Two disks are required for use as secondary memory. System simulations have required around five minutes per month simulated.

^{3/} Commercial designations are given in the interest of specificity of information. Their use does not constitute indorsement by the Army or by BESRL.

Assignment Area

Skill Level	Enlistment Class	C							
		ST 1	ST 2	LT	SB	C1	C2	C3	C4
11 B4		Career	Career	Career	Career	Career	Career	Career	Career
11 B2		Noncareer RA	NC-RA	NC-RA	NC-RA	NC-RA	NC-RA	NC-RA	NC-RA
		Noncareer AUS	NC-AUS	NC-AUS	NC-AUS	NC-AUS	NC-AUS	NC-AUS	NC-AUS
11 B1		Same as 11 B2							

Figure 3. DISTRO Nodes

DESCRIPTION OF THE DISTRO ROUTINES

The GMM contains an option, specified with the variable IDISTON, to utilize an additional group of routines, called the DISTRIBUTION-ROTATION Model or DISTRO. These DISTRO routines project distribution capabilities of the personnel system being simulated by the GMM. As the GMM assigns personnel to node clusters representing tour areas, DISTRO determines how many of these assigned personnel are deployable, or non-transients. At the end of the GMM simulation, DISTRO accounts for other nondeployability factors such as patients and prisoners. It then distributes the remaining "deployable" personnel to smaller groups representing command elements.

This integration of the GMM and DISTRO routines to simulate the assignment-distribution-rotation process is illustrated in Figure 5. Although the logical sequence of the GMM routines remains essentially the same, the interspersed DISTRO routines do slightly modify the assignment process by introducing deployability factors.

The DISTRO application has one main subroutine or driver program, called MAINDST. This subroutine has the same function in the distribution process as the GMM driver program, MAINGMM, has in the rotation-assignment process - it determines the logical sequence of events. If the IDISTON variable is positive, MAINGMM relinquishes control to the MAINDST driver subroutine. In turn, MAINDST either performs the necessary function or relinquishes control to another subroutine. After the distribution calculations are completed, MAINGMM regains control and proceeds with the simulation.

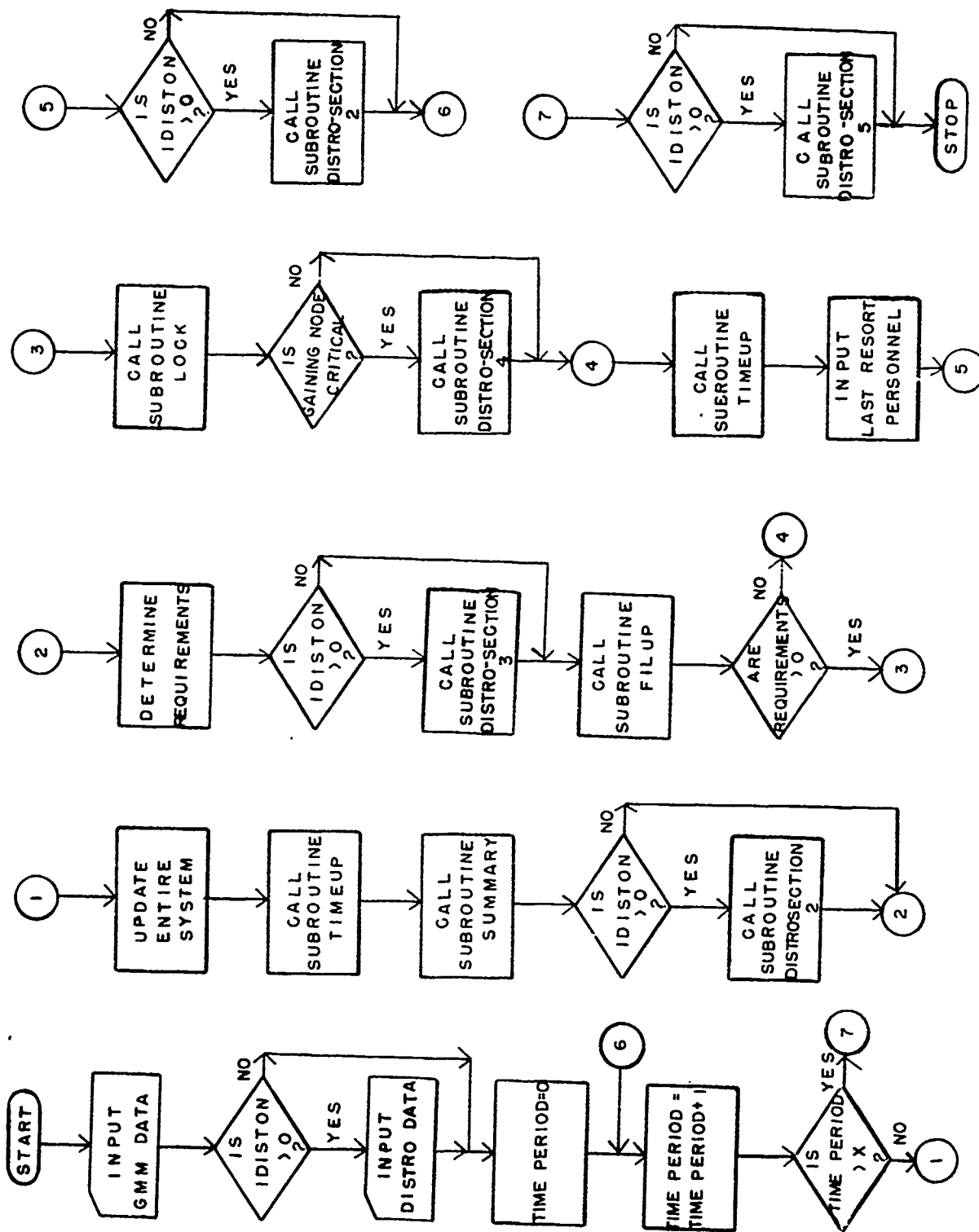


FIGURE 5. INTERFACE OF GMM AND DISTRO.

MAINDST

MAINDST is a subroutine which consists of five sections with separate entry points. Although all five sections are in the same subroutine, they function as separate entities. In order to familiarize the reader with the distribution process, each section will be presented and described in detail.

Section 1 - Entry INPUT

```
C
C   SECTION 1
C   INPUT DISTRIBUTION PARAMETERS
C   ENTRY INPUT
    READ 102,NPRLEV,ISUM
    DO 18 I=1,NPRLEV
      ISTART=I*NT-NT+1
      ISTOP=I*NT
18   READ 101,(PRIO(J),J=ISTART,ISTOP)
      INPR=ISUM*NT
      READ 102,(GRPINPR(I),I=1,INPR)
      READ 102,(INCRNODE(I),I=1,NT)
      READ 102,NUMELEM,NUMMAT
      READ 102,(MATGRPS(I),I=1,NUMELEM)
      READ 102,(BEGROW(I),ENDROW(I),BEGCOL(I),ENDCOL(I),I=1,NUMMAT)
C
    PRINT 103
    PRINT 105
    PRINT 106
    J=0
    DO 16 I=1,NUMELEM
      IF (MATGRPS(I).EQ.0) GO TO 14
      J=J+1
      PRINT 109,MATGRPS(I),BEGROW(J),ENDROW(J),BEGCOL(J),ENDCOL(J)
    GO TO 16
14   PRINT 110
16   CONTINUE
    PRINT 104,(J,PRIO(J),J=1,ISTOP)
    RETURN
```

Prior to the month by month simulation within the GMM, Section 1 inputs distribution parameters. This input consists of seven cards, each containing different variables. Table 1 shows the format and contents of

Table 1

Parameters Input for DISTRO^a

Card 1. (1 Card)	FORMAT(40I2)
NPRLEV, ISUM	
Card 2. (NPRLEV sets of Card 2)	FORMAT(8F10.4)
(PRIO(J), J = 1, NT)	
Card 3. (1 Card)	FORMAT(40I2)
(GRPINPR(I), I = 1, INPR)	
Card 4. (1 Card)	FORMAT(40I2)
(NCRNODE(I), I = 1, NT)	
Card 5. (1 Card)	FORMAT(40I2)
NUMELEM, NUMMAT	
Card 6. (1 Card)	FORMAT(40I2)
(MATGRPS(I), I = 1, NUMELEM)	
Card 7. (1 Card)	FORMAT(40I2)
(BEGROW(I), ENDROW(I), BEGCOL(I), ENDCOL(I), I = 1, NUMMAT)	

^aDISTRO Parameters Input following Card 1 of GMM setup.

these seven cards; the specific variables are defined in Table 2. These parameters determine the characteristics of the total distribution process by describing the nodes which will be jointly distributed, as well as the nondeployability factors. For example, they specify the rows and columns of each matrix node which will represent transients. Since transients are not deployable and cannot fill requirements within command elements, they must be eliminated from the node cluster distribution totals.

Section 2 - Entry ISUMAR

```

C
C      SECTION 2
C      CALLS SUBROUTINE SUMMARY WHICH OBTAINS TOTALS
C      ENTRY ISUMAR
C      INDIV=INTOT=0
C      CALL SUMMARY(NUMLEM,INDIV,INTOT)
C      CALCULATE MAXIMUM DEPLOYABLE AVAILABLE IN TOUR AREA
      J=0
      ISUM1=J=0
      DO 21 I=1,INPR
      IF (GRPINPR(I) .GT. 0) GO TO 17
      J=J+1
      MAXDEPL(J)=0
      GO TO 21
17  ISUM1=ISUM1+1
      MAXDEPL(J)=MAXDEPL(J)+GRPSUM(ISUM1)
21  CONTINUE
      PRINT 117,ISUM1,J
      RETURN

```

Section 2 calculates the total number of deployable personnel, defined as nontransients, within each node and node cluster. The node deployable total consists of all personnel within the matrix node minus personnel in the rows and columns representing transients. The node cluster totals represent personnel who are to be distributed as a single pool, e.g., 11B1's in the short combat tour area.

Table 2

Definitions of Variables Input to DISTRO

1. NPRLEV Number of priority of fill levels.
At each level minimum fill percentages are applied to each node or node cluster requirements to determine the number of additional personnel needed.
2. ISUM Number of tour areas to be distributed. (e.g., ST2-11B1 = one tour area)
3. NT Number of fill percentages per fill level. NT = the number of nodes or node clusters.
4. PRIO(NT) Percentages of fill for node or clusters which are input for each fill level and which act like minimum fill rates.
5. INPR $ISUM + NT$
6. GRPINPR(INPR) Vector designating the tour areas within priorities. A zero designates a new priority group, consisting of the tour areas following the zero. The number of priority groups = the number of zeroes.

7. NCRNODE(I) Vector of critical nodes. A "1" designates that the node corresponding to that element is a critical node which must be filled to the initial fill level regardless of other lower priority node demands. A "0" designates a noncritical node which can be filled only as long as the other nodes maintain their minimum fill levels.
8. NUMELEM Number of elements in the MATGRPS vector.
9. NUMMAT Number of matrices of vectors which are to be summed individually.
10. MATGRPS(NUMELEM) Vector determining which matrices or vectors are to be summed individually and which aggregate sums are to be obtained. Each matrix is summed in the order listed in the vector. Upon reading a zero in the vector, the program calculates an aggregate sum of all matrices since the previous zero.
11. BEGROW(NUMMAT) Vectors which determine respective inclusive row and column boundaries for matrices to be summed.
- ENDROW(NUMMAT)
- BEGCOL(NUMMAT)
- ENDCOL(NUMMAT)
- BEGROW = first row of matrix
- ENDROW = last row of matrix
- BEGCOL = first column of matrix
- ENDCOL = last column of matrix

These boundaries exclude personnel in areas of the matrix which represent transients.

12. PA(ISUM)

Patient or nondeployability rate for each tour area. This percentage is subtracted from the tour area non-transient sum prior to distribution to the command elements.

13. NCAT

Number of command elements to which a tour area is distributed.

14. IDNC(NCAT)

Identification or labels for command elements within a tour area.

IDNC1(NCAT)

15. RATE(NCAT)

Rate of fill for each command element or percentage of authorizations for the command element which must be filled.

16. NAUCAT(NCAT)

Authorization for each command element for a time period.

Section 2 calculates these node and node cluster totals twice within the simulation of each time period - once prior to making any assignments and once after all assignments have been accomplished. The first totals of deployables are used during the assignment process to insure a minimum number of deployable personnel within each node cluster. The minimum level of requirements is compared with the variable MAXDEPL, the maximum number of node cluster deployables, in Section 4 of DISTRO.

After all assignments have been made, the deployable totals are again calculated and stored on disks for use at the end of the simulation. These latter totals minus other nondeployability factors will be distributed to specific command elements.

Section 3 - Entry MODIFY

```

C
C   SECTION 3
C   MODIFICATION OF REQUIREMENTS FOR TIME PERIOD
C   ENTRY MODIFY
      J=LFVEL*NT-NT
      DO 6 I=1,NT
        MIN(I)=0
        J=J+1
        IF(IFILL-1)9,10
      9  NEEDS(I)=NED(I)*PRIO(J)-ACT(I)
        IF(NEEDS(I))3,4,4
      3  NFEDS(I)=0
        GO TO 4
      10 NF(I)=NEE(I)*PRIO(I)-ACTUAL(I)
        IF(NE(I))11,4,4
      11 NF(I)=0
      4  IF(MAXDEPL(I).LT.NEEDS(I))MIN(I)=1
      6  CONTINUE
        IF(IFILL-1)12,13
      12 PRINT 107,(I,NEEDS(I),I=1,NT)
        PRINT 112,(NED(I),I=1,NT)
        PRINT 113,(ACT(I),I=1,NT)
        ISTART=LEVEL*NT-NT+1
        ISTOP=LEVFL*NT
        PRINT 114,LEVEL,(PRIO(I),I=ISTART,ISTOP)
        PRINT 115,(NCRNODE(I),I=1,NT)
        PRINT 116,(GRPINPR(I),I=1,INPR)
        GO TO 5
      13 PRINT 108,(I,NE(I),I=1,NT)
      5  CONTINUE
      RETURN

```

In order to prevent the higher priority nodes from completely depleting the lower priority nodes, MAINDST inputs several levels of fill percentages. The first level of percentages represents a minimum manning level which must be filled for all node clusters, if possible. Successive levels, which may be higher, must be filled only if personnel are available above the minimum manning level. Section 3 multiplies these fill percentages by the node cluster requirements to obtain the manning levels which will actually be filled. Control then returns to the MAINGMM which attempts to fill these requirements. After the first level has been filled, section 3 again modifies the original requirements, this time using the next highest percentages until the last level has been filled or until no more personnel are available for assignment.

Section 4 - Entry MINIMUM

```

C
C   SECTION 4
C   MAINTAINS MINIMUM LEVEL IN TOUR AREAS
C   ENTRY MINIMUM
    IDEMAND=NFEDS(MATOUT)
    IF(INCRNODE(MATIN).EQ. 1) GO TO 25
    IF(MAXDEPL(MATOUT).LE.IDEMAND) GO TO 20
    IF((MAXDEPL(MATOUT)-SYST(M,LEN)).GE.IDEMAND) GO TO 25
    IOVER=MAXDEPL(MATOUT)-IDEMAND
    IHOLD=SYST(M,LEN)-IOVER
    SYST(M,LEN)=IOVER
    GO TO 25
20  IHOLD=SYST(M,LEN)
    SYST(M,LEN)=0
    MIN(MATOUT)=1
25  CONTINUE
    RETURN

```

Section 4 maintains a minimum number of deployable personnel within each node cluster. The node clusters cannot be depleted below this level

unless minimum manning levels within the critical nodes cannot be filled.

When a node has been depleted to its minimum manning level, a flag variable, called MIN, becomes a positive number. This flag signals the search programs in the GMM, called FILUP and LOCK, to stop searching in this particular node. This signal can be overridden only if personnel are needed to fill up to the minimum level in critical nodes.

Section 5 - Entry IADD

```
C
C      SECTI0N 5
C      CALLS SUBROUTINE ADDUP WHICH DISTRIBUTES NONE CLUSTERS AMONG
C      SPECIFIC DISTRIBUTION AREAS.
      ENTRY IADD
      CALL ALLOCATE
      RETURN
```

At the end of the simulation, MAINGMM transfers control to Section 5 of MAINDST, which in turn calls subroutine ALLOCATE. Subroutine ALLOCATE is the real core of the DISTRO routines; it actually distributes the deployable personnel within each node cluster and time period to specific command elements. This distribution process is illustrated in Figure 6. Given the number of nontransient personnel calculated in Section 2 of MAINDST during each time period and the percentage of other nondeployability factors for each node cluster, and given the command element authorizations and fill rates, subroutine ALLOCATE distributes the deployable personnel to their respective command elements.

In order to accomplish this process, subroutine ALLOCATE inputs five different types of cards listed in Table 3 and defined in Table 2. This

Given:

$$(a). \text{Tour Area Total} = \text{Tour Area Total} - \text{Transients} \\ \text{Nontransients} \\ D = \text{Tour Area Total} * (1 - \text{Percent of Nondeployables}) \\ \text{Nontransients}$$

$$(b). A_x = \text{Command Element Authorization}$$

$$R_x = \text{Command Element Rate of Fill}$$

$$\Sigma A = \Sigma (A_x * R_x)$$

Distribute: among Command Elements

Solution:

(a) If D is greater than ΣA ,

Distribute $A_1 * R_1$ to Command Element X_1 ,
 $A_2 * R_2$ to Command Element X_2 , etc.

$$\text{Surplus} = D - \Sigma A$$

(b) If D is less than ΣA ,

Distribute $D / \Sigma A * A_1$ to Command Element X_1 ,
 $D / \Sigma A * A_2$ to Command Element X_2 , etc.

$$\text{Shortfall} = D - \Sigma A$$

FIGURE 6. THE DISTRIBUTION PROCESS IN DISTRO

Table 3

Data Input for DISTRO ^a

Card 1. (1 Card)

FORMAT(8I10)

(PA(I), I = 1, ISUM)

ISUM SETS OF CARDS 2, 3, and 4.

Card 2. (1 Card)

```
FORMAT(I5,(10(A4,A3)))
```

NCAT, (IDNC(J), IDNC1(J), J = 1, NCAT)

Card 3. (1 Card)

FORMAT(16F5.4)

(RATE(J), J = 1, NCAT)

Card 4. (LAST Cards)

FORMAT(8I10)

$$(\text{NAUCAT}(J), J = 1, \text{NCAT})$$

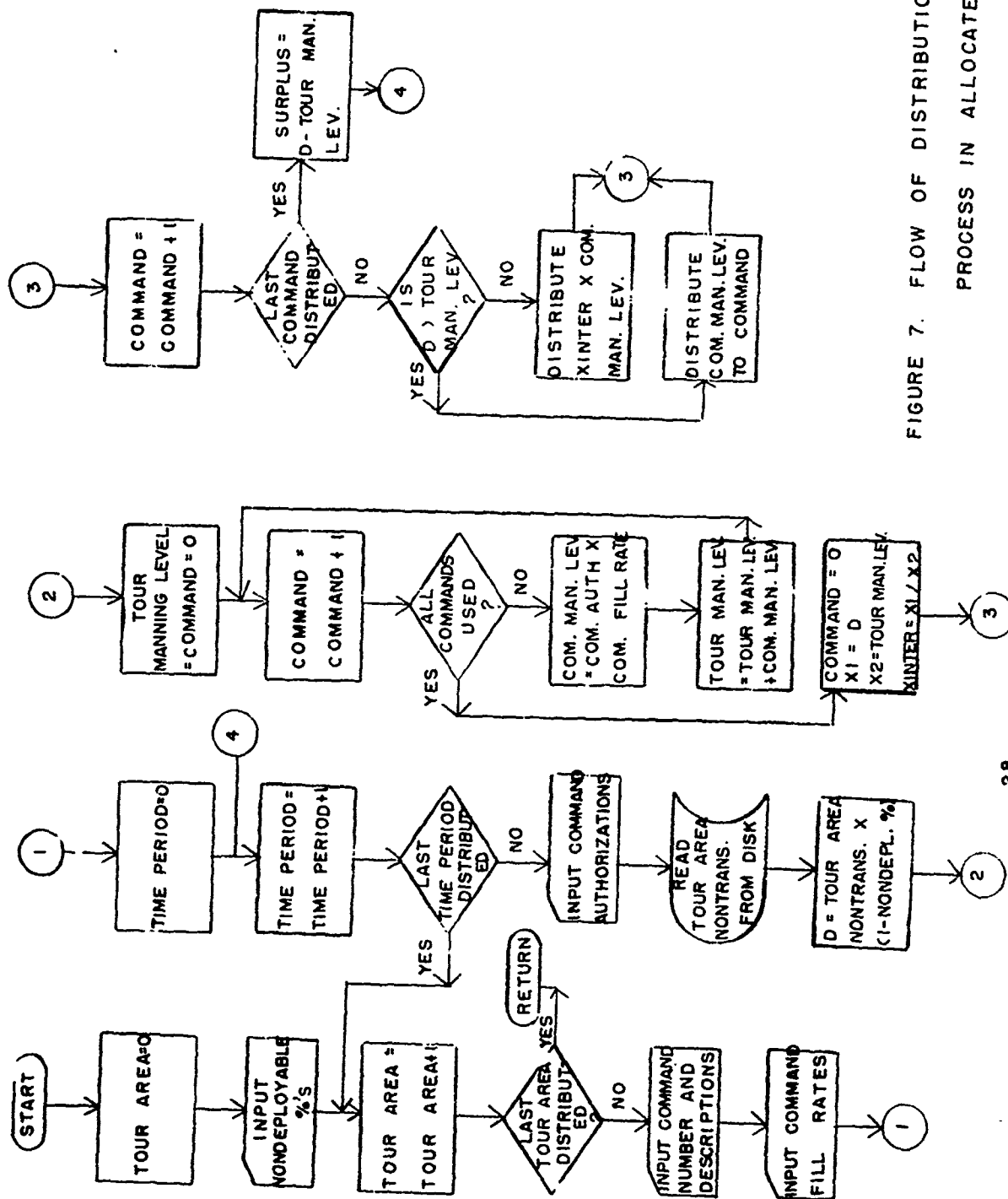
^a DISTRO Data Input follows Card 9 of GMM setup.

data input describes the command elements, their fill rates, and authorizations. Also input are nondeployability percentages for each node cluster. These percentages represent patients, students, and other nondeployables except transients.

The Distribution process in subroutine ALLOCATE, which is flow-charted in Figure 7, will be briefly described. The number of deployable personnel within a node cluster (D) equals the product of the nontransient personnel in that node cluster times one minus the percentage of other nondeployability factors for the node cluster (1-PA). This number, D, must be distributed to command elements which have certain requirements. The total requirements (A) to be matched against D personnel equal the sum of the individual command authorizations times their fill rates. Thus, the problem is simply to distribute D personnel to fill requirements. If there are enough personnel available, i.e., if D is greater than A, then each command element receives its total requirements and the remaining personnel are surplus. Normally, however, manpower requirements exceed the manpower resources, i.e., D is less than A. In this case, each command element receives only a proportion, D/A , of its requirements. (This process is repeated for each node cluster in each time period.) The SIMPO II version of DISTRO will modify subroutine ALLOCATE so that it will distribute all personnel based on the world-wide availability.

The DISTRO output presently lists the following details:

1. node cluster
2. time period
3. node cluster nontransients



4. node cluster nondeployability
5. node cluster deployables (D)
6. command element
7. command element authorization
8. command element fill rate
9. number allocated to command elements
10. surplus

Other information can be output at user's demands.

DISTRO SAMPLE PROBLEM

To expect a computer model, based on broad estimates of parameters and system characteristics, to simulate any system accurately is to expect the impossible. In order to output accurate detailed data meaningful to management, the user must provide at least as detailed and accurate a data base for input to the model. ODCSPER CAD has spent an extensive amount of time providing the limited information we now have available for this sample problem. Nevertheless, the data input still contain many gaps. There are no data on the time spent in the assignment area or on the time in the service for overseas personnel. Only a gross inventory of components (AUS and RA noncareer versus RA career personnel) within each MOS in the command elements is available, etc. Since the detailed input data are difficult, if not impossible, to obtain at the present time, the systems analyst has made some assumptions about the available information in the development of data for this demonstration problem.

SYSTEM DESIGN

The system to be modeled covers eight assignment areas of the Infantry MOS family, 11B. Within this MOS family, there are three skill levels: 11B1, 11B2, and 11B4. These skill levels can be further classified by components of AUS and RA noncareer personnel in the 11B1s and 11B2s and RA career personnel in the 11B4s. In order to model all combinations of these eight assignment areas and five skill level-component categories, 40 matrix

nodes are defined (see Table 4). Each node represents one component within one MOS skill level in a specific assignment area. Within the GMM-DISTRO computer routines, the nodes are identified by both a node number and a node reference number. Table 5, printed as part of the computer output, lists the total number of assets in each of the eight assignment areas, referred to as node clusters, and the assets in each of the 40 individual MOS-component areas, referred to as nodes.

In order to spread the assets throughout the time periods in the individual nodes, the personnel are assumed to be evenly distributed throughout the length of the node. For example, of the 9944 assets within the first node (ST1-11B1-RAs), 904 people are placed in each of the eleven time periods in the node. Time in the service is assumed to have a correspondingly even distribution.

Within each of the 40 nodes, the personnel assets are input by the amount of time which they have spent in the tour, or assignment area, and in the system, or service. Row and column coordinates, representing these respective time dimensions, locate each group of personnel in the node. Using program FILL, these coordinates and the number of people located in the position by the coordinates are written onto a permanent storage disk from which they are input to a temporary storage disk by the Tour Deck Setup cards (see Figure 8 for the complete problem data setup).

TABLE 4

TOUR AREA DESCRIPTION FOR GMM-DISTRO SAMPLE PROBLEM

ASSGN. AREA CODE NO.	TOUR AREA TYPE	CODE NO.	MOS SKILL LEVEL	COMPONENT	NODE NO.	NODE REFERENCE NO.
1	ST 1	1	11B1	NC-RA	1	1,1
				NC-AUS	2	1,2
		2	11B2	NC-RA	3	1,3
				NC-AUS	4	1,4
		3	11B4	CAREER	5	1,5
2	ST 2	4	11B1	NC-RA	6	2,1
				NC-AUS	7	2,2
		5	11B2	NC-RA	8	2,3
				NC-AUS	9	2,4
		6	11B4	CAREER	10	2,5
3	LT	7	11B1	NC-RA	11	3,1
				NC-AUS	12	3,2
		8	11B2	NC-RA	13	3,3
				NC-AUS	14	3,4
		9	11B4	CAREER	15	3,5
4	STAB	10	11B1	NC-RA	16	4,1
				NC-AUS	17	4,2
		11	11B2	NC-RA	18	4,3
				NC-AUS	19	4,4
		12	11B4	CAREER	20	4,5

Table 4 Cont.

ASSGN. AREA CODE NO.	TOUR AREA TYPE	CODE NO.	MOS SKILL LEVEL	COMPONENT	NODE NO.	NODE REFERENCE NO.
5	C 1	13	11B1	NC-RA	21	5,1
				NC-AUS	22	5,2
		14	11B2	NC-RA	23	5,3
				NC-AUS	24	5,4
		15	11B4	CAREER	25	5,5
6	C 2	16	11B1	NC-RA	26	6,1
				NC-AUS	27	6,2
		17	11B2	NC-RA	28	6,3
				NC-AUS	29	6,4
		18	11B4	CAREER	30	6,5
7	C 3	19	11B1	NC-RA	31	7,1
				NC-AUS	32	7,2
		20	11B2	NC-RA	33	7,3
				NC-AUS	34	7,4
		21	11B4	CAREER	35	7,5
8	C 4	22	11B1	NC-RA	36	8,1
				NC-AUS	37	8,2
		23	11B2	NC-RA	38	8,3
				NC-AUS	39	8,4
		24	11B4	CAREER	40	8,5

TABLE 5
ASSETS AT STARTING STATE OF THE SYSTEM

NODE CLUSTER AND NODE TOTALS

NODE CLUSTER 1 = 39081
 NODE 1 = 9944
 NODE 2 = 11869
 NODE 3 = 4264
 NODE 4 = 6020
 NODE 5 = 6984

NODE CLUSTER 2 = 7836
 NODE 6 = 2310
 NODE 7 = 2310
 NODE 8 = 984
 NODE 9 = 984
 NODE 10 = 1248

NODE CLUSTER 3 = 14079
 NODE 11 = 2739
 NODE 12 = 2332
 NODE 13 = 2716
 NODE 14 = 2332
 NODE 15 = 3960

NODE CLUSTER 4 = 7385
 NODE 16 = 924
 NODE 17 = 1133
 NODE 18 = 964
 NODE 19 = 1172
 NODE 20 = 3192

NODE CLUSTER 5 = 15072
 NODE 21 = 1920
 NODE 22 = 2156
 NODE 23 = 3128
 NODE 24 = 3968
 NODE 25 = 3900

NODE CLUSTER 6 = 9669
 NODE 26 = 539
 NODE 27 = 726
 NODE 28 = 1484
 NODE 29 = 1424
 NODE 30 = 5495

NODE CLUSTER 7 = 72
 NODE 31 = 14
 NODE 32 = 0
 NODE 33 = 34
 NODE 34 = 0
 NODE 35 = 24

NODE CLUSTER 8 = 0
 NODE 36 = 0
 NODE 37 = 0
 NODE 38 = 0
 34. NODE 39 = 0
 NODE 40 = 0

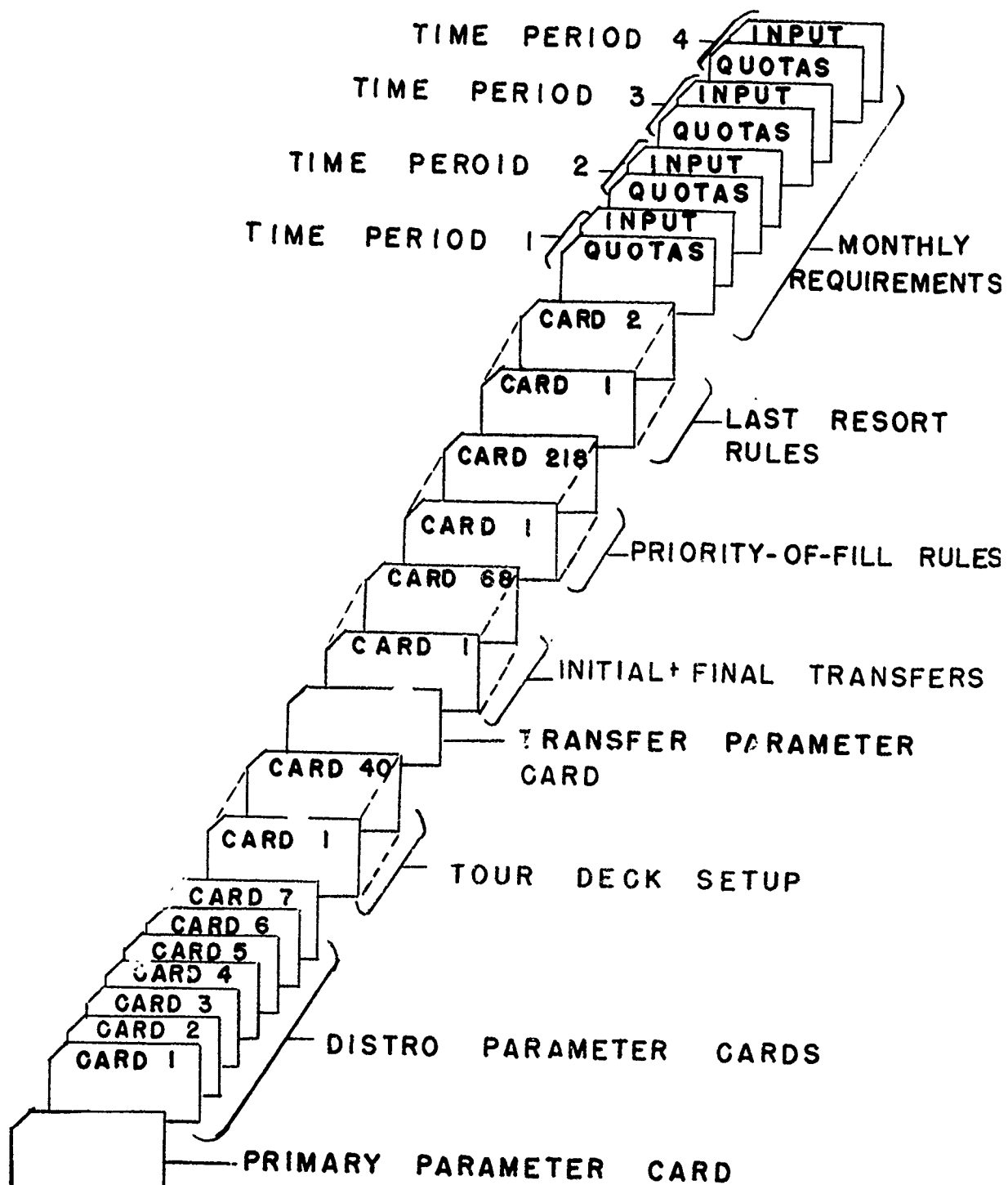


FIGURE 8. DATA INPUT FOR SAMPLE PROBLEM

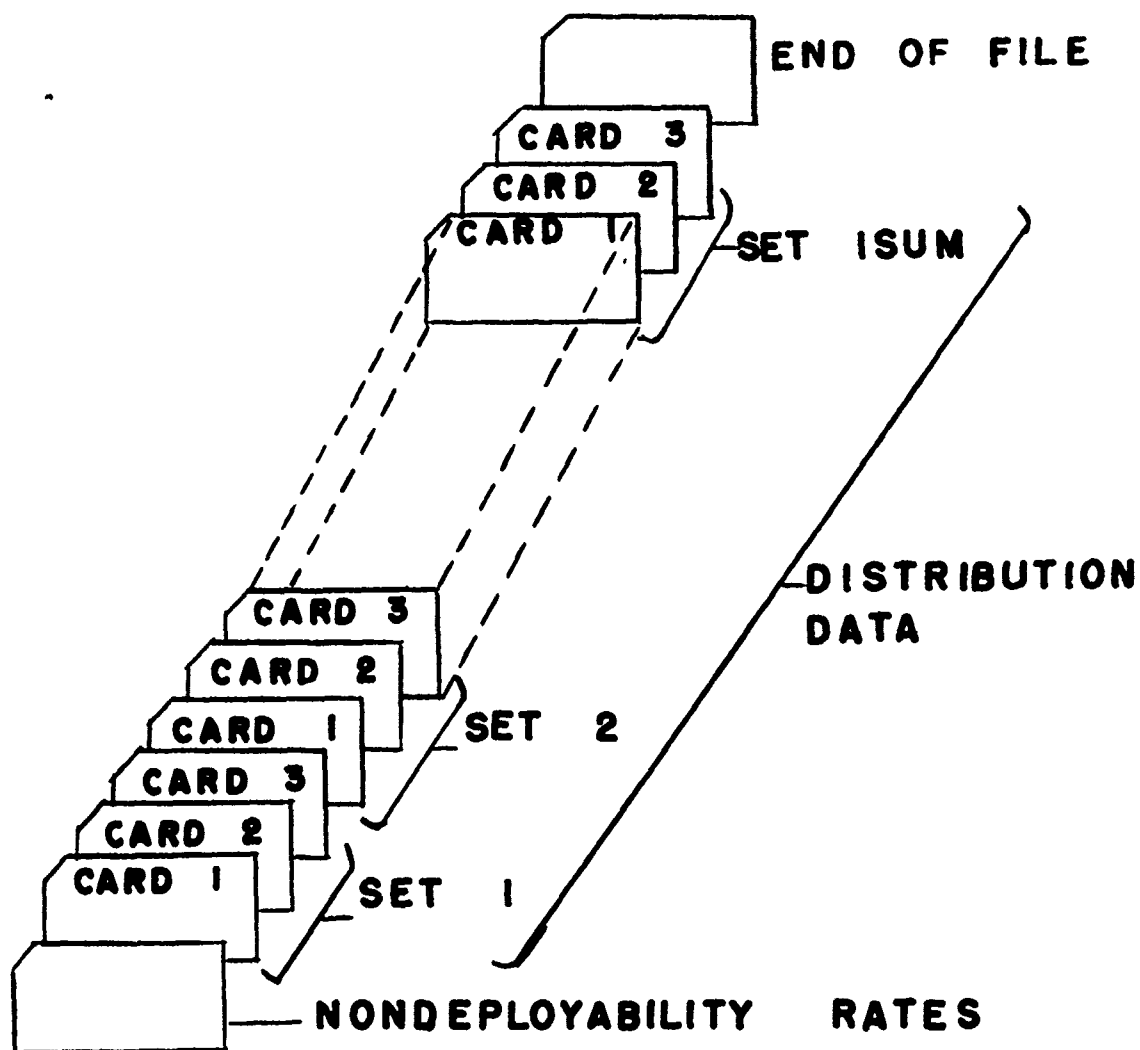


FIGURE 8 CONTINUED.

Table 6 shows the locations of all personnel at the starting state of the system. The printout gives the time in the service and the time in the tour, followed by the number of assets in each nonzero element in the node. For example, in the first node, there are 904 people in their sixth month in the system and their first month in the tour, 904 in their seventh month in the system and their second month in the tour, etc.

Parameters and control vectors input to the GMM are presented in Table 7. The simulation of eight assignment areas (node clusters) and 40 assignment area-skill level-enlistment groups (nodes) will run from month one to month four. Flow rules include 218 priority-of-fill rules, 48 initial and 20 final transfer rules, and two last resort rules. The LENGTH and OUT vectors respectively specify the length of service and the loss rates for each of the 40 nodes. Vectors, which are input at the beginning of each time period, are tour area requirements (NEEDS(1)-NEEDS(4)), and input from outside the system (IOS(1) - IOS(4)).

SYSTEM FLOW

The data to which the GMM-DISTRO simulation is the most sensitive are the flow parameters and rules. These parameters determine how closely the simulated system reflects the real world situation. Careful design and thorough systems analysis must precede this part of the data preparation. For this

TABLE 6

PERSONNEL IN NODES AT THE STARTING STATE OF THE SYSTEM

PERSONNEL NODES		SYS FOUR (COL. ROW)															
1	6 1 904	7 2 904	8 3 904	9 4 904	10 5 904	11 6 904	12 7 904	13 8 904	14 9 904	15 10 904	16 11 904	17 1 904	18 2 904	19 3 904	20 4 904	21 5 904	22 6 904
2	6 1 1079	7 2 1079	8 3 1079	9 4 1079	10 5 1079	11 6 1079	12 7 1079	13 8 1079	14 9 1079	15 10 1079	16 11 1079	17 1 1079	18 2 1079	19 3 1079	20 4 1079	21 5 1079	22 6 1079
3	6 1 1066	7 2 1066	8 3 1066	9 4 1066	10 5 1066	11 6 1066	12 7 1066	13 8 1066	14 9 1066	15 10 1066	16 11 1066	17 1 1066	18 2 1066	19 3 1066	20 4 1066	21 5 1066	22 6 1066
4	6 1 1505	7 2 1505	8 3 1505	9 4 1505	10 5 1505	11 6 1505	12 7 1505	13 8 1505	14 9 1505	15 10 1505	16 11 1505	17 1 1505	18 2 1505	19 3 1505	20 4 1505	21 5 1505	22 6 1505
5	6 1 582	7 2 582	8 3 582	9 4 582	10 5 582	11 6 582	12 7 582	13 8 582	14 9 582	15 10 582	16 11 582	17 1 582	18 2 582	19 3 582	20 4 582	21 5 582	22 6 582
6	6 1 210	7 2 210	8 3 210	9 4 210	10 5 210	11 6 210	12 7 210	13 8 210	14 9 210	15 10 210	16 11 210	17 1 210	18 2 210	19 3 210	20 4 210	21 5 210	22 6 210
7	6 1 210	7 2 210	8 3 210	9 4 210	10 5 210	11 6 210	12 7 210	13 8 210	14 9 210	15 10 210	16 11 210	17 1 210	18 2 210	19 3 210	20 4 210	21 5 210	22 6 210
8	6 1 246	7 2 246	8 3 246	9 4 246	10 5 246	11 6 246	12 7 246	13 8 246	14 9 246	15 10 246	16 11 246	17 1 246	18 2 246	19 3 246	20 4 246	21 5 246	22 6 246
9	6 1 246	7 2 246	8 3 246	9 4 246	10 5 246	11 6 246	12 7 246	13 8 246	14 9 246	15 10 246	16 11 246	17 1 246	18 2 246	19 3 246	20 4 246	21 5 246	22 6 246
10	6 1 104	7 2 104	8 3 104	9 4 104	10 5 104	11 6 104	12 7 104	13 8 104	14 9 104	15 10 104	16 11 104	17 1 104	18 2 104	19 3 104	20 4 104	21 5 104	22 6 104
11	6 1 249	7 2 249	8 3 249	9 4 249	10 5 249	11 6 249	12 7 249	13 8 249	14 9 249	15 10 249	16 11 249	17 1 249	18 2 249	19 3 249	20 4 249	21 5 249	22 6 249
12	6 1 212	7 2 212	8 3 212	9 4 212	10 5 212	11 6 212	12 7 212	13 8 212	14 9 212	15 10 212	16 11 212	17 1 212	18 2 212	19 3 212	20 4 212	21 5 212	22 6 212
13	6 1 679	7 2 679	8 3 679	9 4 679	10 5 679	11 6 679	12 7 679	13 8 679	14 9 679	15 10 679	16 11 679	17 1 679	18 2 679	19 3 679	20 4 679	21 5 679	22 6 679
14	6 1 583	7 2 583	8 3 583	9 4 583	10 5 583	11 6 583	12 7 583	13 8 583	14 9 583	15 10 583	16 11 583	17 1 583	18 2 583	19 3 583	20 4 583	21 5 583	22 6 583
15	6 1 330	7 2 330	8 3 330	9 4 330	10 5 330	11 6 330	12 7 330	13 8 330	14 9 330	15 10 330	16 11 330	17 1 330	18 2 330	19 3 330	20 4 330	21 5 330	22 6 330
16	6 1 84	7 2 84	8 3 84	9 4 84	10 5 84	11 6 84	12 7 84	13 8 84	14 9 84	15 10 84	16 11 84	17 1 84	18 2 84	19 3 84	20 4 84	21 5 84	22 6 84
17	6 1 103	7 2 103	8 3 103	9 4 103	10 5 103	11 6 103	12 7 103	13 8 103	14 9 103	15 10 103	16 11 103	17 1 103	18 2 103	19 3 103	20 4 103	21 5 103	22 6 103
18	6 1 241	7 2 241	8 3 241	9 4 241	10 5 241	11 6 241	12 7 241	13 8 241	14 9 241	15 10 241	16 11 241	17 1 241	18 2 241	19 3 241	20 4 241	21 5 241	22 6 241

Table 6 cont.

[illegible]

TABLE 7

GMM INPUT FOR SAMPLE PROBLEM

<u>PARAMETER NAME</u>	<u>VALUE INPUT</u>			
ID	A2			
NTOUR	8			
IT	40			
FIRST	1			
LAST	4			
IFILL	0			
NP	218			
MAXSUB	5			
CIO	2			
MAXLEN	48			
LRT	2			
PDW	1.00			
IDISTON	1			
IPUNCH	0			
NOIT	68			
NOFIRST	48			
NOLAST	20			
<u>VECTCL. NAME</u>	<u>ELEMENTS IN VECTOR ^a</u>			
NEEDS(1)	53505	7836	14079	7385
	7934	6081	1002	0

^aElements in vectors are presented in a row by row order as they were input for the sample problem.

Table 7 cont.

<u>VECTOR NAME</u>		<u>ELEMENTS IN VECTOR</u>						
NEEDS (2)	53505	7715	14308	7428				
	7965	6100	996	0				
NEEDS (3)	53505	7473	14537	7472				
	7996	6119	991	0				
NEEDS (4)	53505	7473	14766	7515				
	8027	6138	986	0				
IOS (1)	4450	4450						
IOS (2)	4450	4450						
IOS (3)	2575	2575						
IOS (4)	2575	2575						
LENGTH	12	12	12	12	12	13	13	13
	13	13	36	36	36	36	36	26
	26	26	26	26	47	47	47	47
	47	47	47	47	47	47	47	47
	47	47	47	47	47	47	47	47
OUT	.2134	.0970	.1090	.0656	.0892	.2134	.0970	.1090
	.0656	.0892	.2134	.0970	.1090	.0656	.0982	.2134
	.0970	.1090	.0656	.0892	.2134	.0970	.1090	.0656
	.0892	.2134	.0970	.1090	.0656	.0892	.2134	.0970
	.1090	.0656	.0892	.0000	.0000	.0000	.0000	.0000

sample problem the BESRL scientists worked closely with ODCSPER CAD. The complete set of flow rules use in this demonstration run, however, has not been verified by CAD.

Promotions, or horizontal movements, between MOS skill levels are reflected in the initial transfer rules. In the example shown, the following transfers occur:

- At the 17th time period, 90% of the 11B1s are promoted to the 11B2s.
- At the 21st time period, 90% of the 11B2s (RA) and 5% of the 11B2s (AUS) are promoted to the 11B4s (RA); 1% of the remaining 11B2s (AUS) and 1 % of the 11B1s (AUS) are lost or transferred out of the system.
- At the end of the 33rd time period, 100% of the 11B1s (RA) and 11B2s (RA) are lost to the system.

In order to reflect these horizontal movements, 48 initial transfer rules were generated as shown in a computer printout, Table 8. The user must input a separate rule for each node to node movement. In this demonstration run, transfers, or horizontal movements, were not made in the CONUS after CONUS (C3) and the CONUS after STAB (C4) tours.

The following rules of vertical movement, flow between assignment area nodes, were modeled:

1. Movement time from receipt of orders to movement is three months including one month transient time, i.e., from the time a group is ordered to the ST, three months will elapse before they arrive in the ST.
2. Two months delay from graduation from AIT until they can be ordered to ST. (Thus for individuals ordered to CONUS and then to ST, total time to reporting is five months, combining remarks 1 & 2.)
3. Transient time for moves from overseas to CONUS is one month.

TABLE 8

43

4. No movement between STs.
5. Long tour first term assets in Europe must serve six months before they can be sent to ST.
6. No one stays in any command longer than 36 months.
7. Alaska and SouthCom are not part of the sustaining base.
8. STRAF I forces are deploying units and are not part of the sustaining base.

In order to cover these movements, the following general priorities of assignment were developed with three priority levels of fill, r_1 , r_2 , and r_3 .

<u>INTO</u>	<u>FROM</u>	<u>AFTER</u>
1. ST1 and r_2 * ST2	C4	0
	C1	5
	C3	25
	C2	25
	SB	25
	SB	18
	C3	18
	C2	18
	C3	12

2. LT * r_3	C4	0
	C1	5
	C3	25
	C2	25

<u>INTO</u>	<u>FROM</u>	<u>AFTER</u>
	SB	18
	C3	18
	C2	18
	C3	12
	C2	12

3. SB	ST1	12
	ST2	13
	LT	36
	C2	25
	C2	18
	C2	12
	C3	25
	C3	18
	C3	12
	C2	3
	C3	3

4. C2	ST1	12
	ST2	13

5. C3	LT	36

Test: Add C1, C2, C3, and SB for months K through the last
month minus the number of months transiency simulated.

(Where K = no. months transiency at the first of the

tour + 1.) If the number in the CONUS tours is less than r_i * the tour authorizations, stop searching. If these tours have more than r_i * the tour authorizations, or if the ST2 and/or LT are critical node clusters, continue searching until the ST2 and LT assets equal 100% * their authorizations.

<u>INFO</u>	<u>FROM</u>	<u>AFTER</u>
6. ST2 (up to	C4	0
100%)	C1	5
	C3	25
	C2	25
	SB	25
	SB	18
	C3	18
	C2	18
	C3	12

7. LT (up to	C1	5
100%)	C3	25
	C2	25
	SB	18
	C3	18
	C2	18
	C3	12

Preparing these general priorities of assignment for input to the computer model requires further specificity of the movement between individual nodes. To demonstrate the complexity of developing these detailed priority-of-fill rules, Table 9 lists the 218 rules input for this simulation. For example, 33 rules are needed to specify the flow into the ST1 area. It is important to note that the order in which the priorities are specified determines the flow in the system. The order can reflect subtle assignment procedures, as well as an assignment area priority hierarchy. It is crucial, therefore, to have a close interaction of the systems analyst and the military personnel in order to validate these rules of flow.

The 20 final transfer rules (see last 20 rules in Table 8) in this problem take care of the returnees from the ST1, ST2, LT, SB, and C1 tours who are not needed to fill requirements in other tour areas. These personnel enter the C2, C3, and C4 tour areas.

The Last Resort Tour rules move to the C1 tour area all new system input which is not needed to fill node requirements. In this sample problem, only two rules are employed (see the last two lines of printout in Table 9).

DISTRIBUTION DATA

Since all personnel available for an assignment area are assigned without regard to their component or time of enlistment,

TABLE 9
PRIORITY-OF-FILL RULES FOR SAMPLE PROBLEM

FILL PRIORITIES FOR SIMULATION A 2

100 PERCENT	FRJ4	4. 1	AFTER	0PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 2	AFTER	0PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 3	AFTER	0PERIODS	INTO	1. 3	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 4	AFTER	0PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 5	AFTER	0PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	5. 1	AFTER	5PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	5. 2	AFTER	5PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 1	AFTER	25PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 2	AFTER	25PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 1	AFTER	25PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 2	AFTER	25PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 1	AFTER	10PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 2	AFTER	10PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 1	AFTER	10PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 2	AFTER	10PERIODS	INTO	1. 2	MOVEMENT TYPE 0
100 PERCENT	FRJ4	5. 1	AFTER	5PERIODS	INTO	1. 1	MOVEMENT TYPE 0
100 PERCENT	FRJ4	5. 4	AFTER	5PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 3	AFTER	25PERIODS	INTO	1. 3	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 4	AFTER	25PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 3	AFTER	25PERIODS	INTO	1. 3	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 4	AFTER	25PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 3	AFTER	10PERIODS	INTO	1. 3	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 4	AFTER	10PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 3	AFTER	10PERIODS	INTO	1. 3	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 4	AFTER	10PERIODS	INTO	1. 4	MOVEMENT TYPE 0
100 PERCENT	FRJ4	5. 5	AFTER	5PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	7. 5	AFTER	25PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 5	AFTER	25PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 5	AFTER	25PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 5	AFTER	10PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	7. 5	AFTER	10PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	6. 5	AFTER	10PERIODS	INTO	1. 5	MOVEMENT TYPE 0
100 PERCENT	FRJ4	4. 1	AFTER	0PERIODS	INTO	2. 1	MOVEMENT TYPE 0
0 PERCENT	FRJ4	4. 2	AFTER	0PERIODS	INTO	2. 2	MOVEMENT TYPE 0
0 PERCENT	FRJ4	4. 3	AFTER	0PERIODS	INTO	2. 3	MOVEMENT TYPE 0
0 PERCENT	FRJ4	4. 4	AFTER	0PERIODS	INTO	2. 4	MOVEMENT TYPE 0
0 PERCENT	FRJ4	4. 5	AFTER	0PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	5. 1	AFTER	5PERIODS	INTO	2. 1	MOVEMENT TYPE 0
85 PERCENT	FRJ4	5. 2	AFTER	5PERIODS	INTO	2. 2	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 1	AFTER	25PERIODS	INTO	2. 1	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 2	AFTER	25PERIODS	INTO	2. 2	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 1	AFTER	25PERIODS	INTO	2. 1	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 2	AFTER	25PERIODS	INTO	2. 2	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 1	AFTER	10PERIODS	INTO	2. 1	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 2	AFTER	10PERIODS	INTO	2. 2	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 1	AFTER	10PERIODS	INTO	2. 1	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 2	AFTER	10PERIODS	INTO	2. 2	MOVEMENT TYPE 0
85 PERCENT	FRJ4	5. 1	AFTER	5PERIODS	INTO	2. 3	MOVEMENT TYPE 0
85 PERCENT	FRJ4	5. 4	AFTER	5PERIODS	INTO	2. 4	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 3	AFTER	25PERIODS	INTO	2. 3	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 4	AFTER	25PERIODS	INTO	2. 4	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 3	AFTER	25PERIODS	INTO	2. 3	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 4	AFTER	25PERIODS	INTO	2. 4	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 3	AFTER	10PERIODS	INTO	2. 3	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 4	AFTER	10PERIODS	INTO	2. 4	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 3	AFTER	10PERIODS	INTO	2. 3	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 4	AFTER	10PERIODS	INTO	2. 4	MOVEMENT TYPE 0
85 PERCENT	FRJ4	7. 5	AFTER	25PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 5	AFTER	25PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 5	AFTER	25PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	4. 5	AFTER	10PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	7. 5	AFTER	10PERIODS	INTO	2. 5	MOVEMENT TYPE 0
85 PERCENT	FRJ4	6. 5	AFTER	10PERIODS	INTO	2. 5	MOVEMENT TYPE 0

2/ In the computer program, 85 and 100% are treated as 100%.

[illegible]

Table 9 cont.

[illegible]

the 40 nodes are collected into 24 assignment area - MOS skill level groups, or tour areas, for distribution to command elements (refer to Table 4). For example, tour area one includes all RA and AUS 11B1s in the ST1. During the GMM simulation, the total minus transients in these tour areas is calculated and stored on a disk for later distribution into the command elements. The specific command elements within each of these tour areas are listed in Table 10.

In order to distribute these tour areas into command elements, the user must input distribution parameters and details for determining manning levels in the specific command elements. Table 11 lists the necessary parameters and vectors input to DISTRO. The three PRIO vectors specify fill percentages which apply during the GMM simulation. The PRIO(1) vector serves as a minimum fill level for all node clusters. For example, authorizations for the second node cluster (ST2) must be filled to 85 percent unless there are needs in the critical node ST1. (Note that in the NCRNODE vector the first element, which corresponds to the ST1, equals one.) In order to apply these fill rates, the vector GRPINPR directs the program to sum the first three nodes and use these assets to fill the first node cluster quota.

The MATGRPS vector directs the calculation of 24 tour area sums of nontransients. The program will sum the nontransients in the first and second nodes, the third and fourth

TABLE 10

FOUR AREA DISTRIBUTIONS TO COMMAND ELEMENTS

<u>CODE</u>	<u>FOUR AREA DESCRIPTION</u>	<u>ID CODE</u>	<u>COMMAND ELEMENT DESCRIPTION</u>
1	11B1-ST1	1A	Republic of Vietnam
	11B1-ST1	2A	Republic of Vietnam
	11B1-ST1	3A	Republic of Vietnam
	11B1-ST2	4A	Thailand, Stratcom
		4B	Korea
2	11B2-ST2	5A	Thailand, Stratcom
		5B	Korea
	11B4-ST2	6A	Thailand, Stratcom
		6B	Korea
	11B1-LT	7A	Alaska, Southcom, Japan, AF II
		7B	Europe
	11B2-LT	8A	Alaska, Southcom, Japan, AF II
		8B	Europe
	11B4-LT	9A	Alaska, Southcom, Japan, AF II
		9B	Europe
1	11B1-STAS	10A	STRAF II
		10B	Joint Act

Table 10 cont.

<u>CODE NO.</u>	<u>TOUR AREA DESCRIPTION</u>	<u>ID CODE</u>	<u>COMMAND ELEMENT DESCRIPTION</u>
11	11B2-STAB	11A	STRAF II
		11B	Joint Act
12	11B4-STAB	12A	STRAF II
		12B	Joint Act
13	11B1-C1 (Before O/S)	13A	CDC
		13B	ARADCOM
		13C	AMC
		13D	STRAF III
		13E	STRAF I
		13F	Training Base
14	11B2-C1	14A	CDC
		14B	ARADCOM
		14C	AMC
		14D	STRAF III
		14E	STRAF I
		14F	Training Base
15	11B4-C1	15A	CDC
		15B	ARADCOM
		15C	AMC
		15D	STRAF III
		15E	STRAF I
		15F	Training Base

Table 10 cont.

<u>CODE NO.</u>	<u>TOUR AREA DESCRIPTION</u>	<u>ID CODE</u>	<u>COMMAND ELEMENT DESCRIPTION</u>
16	11B1-C2 (After ST)	16A	CDC
		16B	ARADCOM
		16C	AMC
		16D	STRAF III
		16E	STRAF I
		16F	Training Base
17	11B2-C2	17A	CDC
		17B	ARADCOM
		17C	AMC
		17D	STRAF III
		17E	STRAF I
		17F	Training Base
18	11B4-C2	18A	CDC
		18B	ARADCOM
		18C	AMC
		18D	STRAF III
		18E	STRAF I
		18F	Training Base
19	11B1-C3 (After LT)	19A	CDC
		19B	ARADCOM
		19C	AMC
		19D	STRAF III
		19E	STRAF I
		19F	Training Base

Table 10 cont.

<u>CODE NO.</u>	<u>TOUR AREA DESCRIPTION</u>	<u>ID CODE</u>	<u>COLLAPSED ELEMENT DESCRIPTION</u>
20	11B2-C3	20A	CDC
		20B	ARADCOM
		20C	AMC
		20D	STRAF III
		20E	STRAF I
		20F	Trainin_ Base
21	11B2-C3	21A	CDC
		21B	ARADCOM
		21C	AMC
		21D	STRAF III
		21E	STRAF I
		21F	Training Base
22	11B1-C4 (After CONUS)	22A	CDC
		22B	ARADCOM
		22C	AMC
		22D	STRAF III
		22E	STRAF I
		22F	Trainin_ Base
23	11B2-C4	23A	CDC
		23B	ARADCOM
		23C	AMC
		23D	STRAF III
		23E	STRAF I
		23F	Trainin_ Base

Table 10 cont.

<u>CODE NO.</u>	<u>TOUR AREA DESCRIPTION</u>	<u>ID CODE</u>	<u>COMMAND ELEMENT DESCRIPTION</u>
24	11B4-C4	24A	CDC
		24B	ARADCOM
		24C	AMC
		24D	STRAF III
		24E	STRAF I
		24F	Training Base

TABLE 11

DISTRO PARAMETERS INPUT FOR SAMPLE PROBLEM

<u>PARAMETER NAME</u>	<u>VALUE INPUT</u>							
NPRLEV	3							
ISUM	24							
NUMELEM	64							
NUMMAT	40							
<u>VECTOR NAME</u>	<u>ELEMENTS IN VECTOR^a</u>							
PRI0(1)	1.00	.85	.50	.50	.50	.50	.50	.00
PRI0(2)	1.00	1.00	.75	.75	.75	.75	.75	.00
PRI0(3)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00
GRINPR	0	1	2	3	0	4	5	6
	0	7	8	9	0	10	11	12
	0	13	14	15	0	16	17	18
	0	19	20	21	0	22	23	24
NCRNODE	1	0	0	0	0	0	0	0
MATGRPS	1	2	0	3	4	0	5	0
	6	7	0	8	9	0	10	0
	11	12	0	13	14	0	15	0
	16	17	0	18	19	0	20	0
	21	22	0	23	24	0	25	0
	26	27	0	28	29	0	30	0
	31	32	0	33	34	0	35	0
	36	37	0	38	39	0	40	0
BEGROW	BEGROW (1) to BEGROW (35) = 2 BEGROW (36) to BEGROW (40) = 1							

^a Elements in vectors are presented in a row by row order as they are input.

Table 11 cont.

<u>VECTOR NAME</u>	<u>ELEMENTS IN VECTOR</u>							
ENDROW	13.	13	13	13	13	14	14	14
	14	14	37	37	37	37	37	27
	27	27	27	27	47	47	47	47
	47	47	47	47	47	47	42	42
	42	42	42					
BEGCOL	BEGCOL(1) to BEGCOL(40) = 1							
ENDCOL	ENDCOL(1) to ENDCOL(40) = 48							
PA	.30	.30	.30	.20	.20	.20	.10	.10
	.10	.05	.05	.05	.02	.02	.02	.01
	.01	.01	.00	.00	.00	.00	.00	.00

nodes, etc. These nontransients (see the first four elements in each of the BEGROW, ENDROW, BEGCOL, and ENDCOL vectors) are found in rows 2 to 13 and in columns 1 to 48 of each node.

After the month by month simulation occurs, the non-transient totals for the 24 tour areas are distributed to specific command elements based on the data input described in Table 12. The tour areas are distributed in the order listed. After applying nondeployability rates (PA in Table 11) to each tour area nontransient total, command authorizations and fill rates are input to determine manning levels for each command element. In this problem, all command elements within a given tour area have the same fill rates. These rates may, however, vary for each command element. For the 11B4s in the STL, or tour area three, this means that 100% of the 9096 authorizations for the first time period should be filled, if possible.

OUTPUT FOR THE SAMPLE PROBLEM

The output for the GMM-DISTRO, shown for this sample problem, is based on the need to check the program. Other output and summary statistics routines will be developed according to users' demands.

Initially, GMM-DISTRO prints a summary of the DISTRO parameters (see Table 13), including the nodes which are grouped together into tour areas, and the time periods within

TABLE 12

DISTRO COMMAND ELEMENT DATA FOR SAMPLE PROBLEM

TOUR AREA	FILL RATE	COMMAND ELEMENT					
		IDENT.		AUTHORIZATIONS FOR TIME PERIODS			
				<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
1	1.00	11B1	S1A	28358	28358	28358	28358
2	1.00	11B2	S1A	16051	16051	16051	16051
3	1.00	11B4	S1A	9096	9096	9096	9096
4	.85	11B1	S2A	79	77	76	75
			S2B	4544	4475	4404	4334
5	.85	11B2	S2A	78	77	76	75
			S2B	1881	1852	1822	1793
6	.85	11B4	S2A	79	78	89	75
			S2B	1175	1156	1326	1121
7	.50	11B1	LTA	846	860	874	888
			LTB	4222	4291	4359	4428
8	.50	11B2	LTA	983	999	1015	1031
			LTB	4085	4152	4218	4285

Table 12 Cont.

TOUR AREA	FILL RATE	COMMAND ELEMENT					
		IDENT.		AUTHORIZATIONS FOR TIME PERIODS			
				<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
9	.50	11B4	LTA	844	857	871	885
			LTB	3098	3149	3199	3249
10	.40	11B1	SBA	2068	2080	2092	2104
			SBB	0	0	0	0
11	.40	11B2	SBA	74	75	75	76
			SBB	1994	2005	2017	2028
12	.40	11B4	SBA	1254	1261	1269	1277
			SBB	1995	2007	2019	2030
13	.30	11B1	CIA	31	32	32	32
			CIB	8	8	8	8
			CIC	23	23	23	23
			CID	358	360	361	362
			CIE	270	271	272	273
			CIF	1404	1409	1414	1420
14	.30	11B2	CIA	128	128	129	129
			CIB	8	8	8	8
			CIC	8	8	8	8

Table 12 Cont.

TOUR AREA	FILL RATE	IDENT.	COMMAND ELEMENT			
			AUTHORIZATIONS FOR TIME PERIODS			
			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
		CID	3246	3258	3271	3284
		CIE	315	316	318	319
		CIF	49	49	49	49
15	.30	11B4 CIA	40	40	40	40
		CIB	8	8	8	8
		CIC	8	8	8	8
		CID	357	358	360	361
		CIE	104	105	105	106
		CIF	1569	1575	1581	587
16	.20	11B1 C2A	12	12	12	12
		C2B	6	6	6	6
		C2C	6	6	6	6
		C2D	158	158	159	159
		C2E	116	116	117	117
		C2F	614	616	618	620
17	.20	11B2 C2A	55	55	56	56
		C2B	7	7	7	7
		C2C	7	7	7	7

Table 12 Cont.

COMMAND ELEMENT							
TOUR AREA	FILL RATE	IDENT.	AUTHORIZATIONS FOR TIME PERIODS				
			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	
18	.20	11B4	C2D	1428	1432	1437	1442
			C2E	139	139	140	140
			C2F	37	37	37	37
			C2A	73	74	74	74
			C2B	7	7	7	7
			C2C	10	11	11	11
			C2D	601	603	605	607
			C2E	171	172	172	173
			C2F	2633	2641	2649	2657
19	.10	11B1	C3A	0	0	0	0
			C3B	0	0	0	0
			C3C	0	0	0	44
			C3D	45	45	45	44
			C3E	30	30	30	179
			C3F	182	181	181	0
20	.10	11B2	C3A	15	15	15	15
			C3B	0	0	0	0
			C3C	0	0	0	0
			C3D	426	421	421	419

Table 12 Cont.

TOUR AREA	FILL RATE	IDENT.	COMMAND ELEMENT			
			AUTHORIZATIONS FOR TIME PERIODS			
			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
		C3E	45	45	45	44
		C3F	15	15	15	15
21	.10	11B4 C3A	0	0	0	0
		⋮	⋮	⋮	⋮	⋮
		C3D	0	0	0	0
		C3E	15	15	15	15
		C3F	228	227	226	225
22	.30	11B1 C4A	0	0	0	0
		⋮	⋮	⋮	⋮	⋮
		C4F	0	0	0	0
23	.30	11B2 C4A	0	0	0	0
		⋮	⋮	⋮	⋮	⋮
		C4F	0	0	0	0
24	.30	11B4 C4A	0	0	0	0
		⋮	⋮	⋮	⋮	⋮
		C4F	0	0	0	0

TABLE 13

DISTRO PARAMETERS

DISTRIBUTION PARAMETERS

NONDEPLOYABLES AT BEGINNING AND END OF
MATRICES WITHIN NODE CLUSTERS

MATRIX	FIRST ROW	LAST ROW	FIRST COL	LAST COL
1	2	13	1	48
2	2	13	1	48
3	2	13	1	48
4	2	13	1	48
5	2	13	1	48
6	2	14	1	48
7	2	14	1	48
8	2	14	1	48
9	2	14	1	48
10	2	14	1	48
11	2	37	1	48
12	2	37	1	48
13	2	37	1	48
14	2	37	1	48
15	2	37	1	48
16	2	27	1	48
17	2	27	1	48
18	2	27	1	48
19	2	27	1	48
20	2	27	1	48
21	2	47	1	48
22	2	47	1	48
23	2	47	1	48
24	2	47	1	48
25	2	47	1	48

Table 13 cont.

26	2	47	1	48
~~27~~	~~2~~	~~47~~	~~1~~	~~48~~
~~28~~	~~2~~	~~47~~	~~1~~	~~48~~
29	2	47	1	48
30	2	47	1	48
31	2	47	1	48
32	2	47	1	48
33	2	47	1	48
~~34~~	~~2~~	~~47~~	~~1~~	~~48~~
~~35~~	~~2~~	~~47~~	~~1~~	~~48~~
~~36~~	~~1~~	~~42~~	~~1~~	~~48~~
37	1	42	1	48
38	1	42	1	48
39	1	42	1	48
40	1	42	1	48

the nodes which define nontransients. Then the GMM flow rules are presented (see Tables 8 and 9). First the transfer flow rules are printed, telling the percentages which are removed from a losing node at a specified time and are input to a gaining node at another specified time period. When the people leave and enter the same cells of the losing and gaining nodes, the user inputs a zero, or blank, for the variable PERDFO.

The fill priorities are then printed. In these rules, a zero percent removed from a node is handled identically to 100 percent removed to make the data preparation easier. When a rule says AFTER 5 periods, personnel are removed in the 5 + 1 time period in the node. Movement type 0 means they will be input into the first time period in the gaining assignment node and in the same time period in the system as in the losing node. This is equivalent to the type 1 flow. Following these priority-of-fill rules are the Last Resort Tour rules (see the last two printout lines of Table 9). In this problem, the two unassigned input categories will be sent to C1.

The personnel system simulated is printed as a group of personnel nodes which include the time in the system and the time in the tour (or node) for all people in the nodes. Zero elements are not printed to conserve space. The starting state of the personnel nodes is printed in Table 6.

At this point in the program, the nodes are updated and the simulation process begins. If any personnel complete LENGTH time periods in a node, a list of these personnel, who are available for another tour assignment, is printed. Since none of the people complete a tour at this time, there is no print-out.

Node and node cluster totals are printed. These totals equal the personnel in Table 6 minus personnel who have completed the tours in the update. In this case, the totals are identical to the original matrix since no personnel have completed LENGTH months in the tour. Node and node cluster deployables, defined by the rows and columns which are totaled, are printed as "Output from Subroutine Summary." (see Table 14) These totals of deployables are calculated after the initial transfers and prior to the application of the priority-of-fill rules. For example, the 16th and 17th nodes, defined in Table 4 as NC-RA and NC-AUS 11B1s in the SB, have 924 and 1133 people respectively in the second to the 27th month in the SB tour area and in the first to the 48th month in the system. These personnel collectively equal 2057 nontransient personnel for the SB-11B1 tour area. The sum of 2057, 2136, and 3192 equals the SB deployable total, used as a minimum level below which the SB cannot be depleted unless the SB quotas drop below this total, or personnel are needed for the critical ST1.

TABLE 14

DEPLOYABLES CALCULATED AFTER FIRST UPDATE OF SYSTEM

SHEET FIRST SUBROUTINE SUMMARY

SECTION	MODE	MODE TOTAL	ROWS	COLUMNS	CLUSTER TOTAL
1	1	9944	2-13	1-48	
1	2	11559	2-13	1-48	
					21813
1	3	4264	2-13	1-48	
1	4	6020	2-13	1-48	
					10284
1	5	6402	2-13	1-48	
					6402
1	6	2310	2-14	1-48	
1	7	2310	2-14	1-48	
					4620
1	8	944	2-14	1-48	
1	9	944	2-14	1-48	
					1968
1	10	1248	2-14	1-48	
					1248
1	11	2739	2-37	1-48	
1	12	2332	2-37	1-48	
					5071
1	13	2716	2-37	1-48	
1	14	2332	2-37	1-48	
					5048
1	15	3950	2-37	1-48	
					3950
1	16	924	2-27	1-48	
1	17	1133	2-27	1-48	
					2057
1	18	964	2-27	1-48	
1	19	1172	2-27	1-48	
					2136
1	20	3192	2-27	1-48	
					3192
1	21	640	2-47	1-48	
1	22	794	2-47	1-48	
					1424
1	23	3128	2-47	1-48	
1	24	3950	2-47	1-48	
					7096
1	25	1300	2-47	1-48	
					1300
1	26	539	2-47	1-48	
1	27	726	2-47	1-48	
					1265
1	28	1444	2-47	1-48	
1	29	1424	2-47	1-48	
					2908
1	30	5496	2-47	1-48	
					5496
1	31	14	2-47	1-48	
1	32	0	2-47	1-48	
					14
1	33	34	2-47	1-48	
1	34	0	2-47	1-48	
					34
1	35	22	2-47	1-48	
					22
1	36	0	1-42	1-48	
1	37	0	1-42	1-48	
					0
1	38	0	1-42	1-48	
1	39	0	1-42	1-48	
					0
1	40	0	1-42	1-48	
					0

As the program begins to apply the priority-of-fill rules, node cluster requirements and shortages, and node requirements and shortages are printed. In this run, only node cluster requirements are used, so the node requirements and shortages are output as zeroes. For each level of priorities, intermediate output of node cluster fill rates (PRIO), quotas (NED), assets (ACT), and modified needs, calculated by multiplying PRIO times NED and subtracting ACT, are printed (see Table 15).

After all of the priority-of-fill rules have been applied, Subroutine Summary again outputs totals of deployables in the nodes (Table 16), followed by the personnel node distribution (Table 17). This printout of the personnel nodes includes the new personnel input with the application of the priority-of-fill rules.

The final printout for the first time period is a summary of all personnel flow, or movement, which has taken place using the priority-of-fill, the initial transfer, final transfer, and last resort tour rules. Table 18 shows the printout for the first time period. The output columns respectively describe the gaining node cluster and node, the losing node cluster and node, the number of personnel input to the gaining node, the number lost to the system, and the time period in the system and in the tour of the gaining node where the personnel were placed. For example, the first row indicates that 124 men were

TABLE 15

NODE AND NODE CLUSTER REQUIREMENTS

TOTAL CLUSTER NEEDS =									
	53505	7836	14079	7385	7934	6081	1002	0	
NODE CLUSTER SHORTAGES = 14424									
NODE SHORTAGES =									
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
NODE SHORTAGES =									
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

MODIFIED NEEDS FOR NODE CLUSTERS

NODE CLUSTER NEEDS
14424

2 0
3 0
4 0
5 0
6 0
7 429
8 0

ACT = 53505 7836 14079 7385 7934 6081 1002 0
LEVEL = 39081 7836 14079 7385 15072 9669 72 0

PMU = 1.000 .050 .500 .500 .500 .500 .500 .500 .500 .500
CRITICAL NODE VECTOR. 1 = A CRITICAL NODE. 0 = NONCRITICAL
1 0 0 0 0 0 0 0 0 0

Table 15 cont.

MODIFIED NEEDS FOR NODE CLUSTERS

NODE CLUSTER	NEEDS
1	965H
2	0
3	0
4	0
5	0
6	0
7	681
8	0

MEM = 53505 7936 14079 7385 7934 6081

ACT = 43447 7835 14079 7385 14270 9669

LEVEL 2

PRIO = 1.0001.000 .750 .750 .750 .750 0

1002 0

70 0

MODIFIED NEEDS FOR NODE CLUSTERS

NODE CLUSTER	NEEDS
1	965H
2	0
3	0
4	0
5	0
6	0
7	932
8	0

MEM = 53505 7836 14079 7385 7934 6081

ACT = 43447 7836 14079 7385 14270 9669

LEVEL 3

PRIO = 1.0001.0001.0001.0001.0001.000 0

1002 0

70 0

TABLE 16

NONTRANSIENT PERSONNEL ELIGIBLE FOR DISTRIBUTION

OUTPUT FROM SUBROUTINE SUMMARY

PERIOD	CODE	NODE TOTAL	ROWS	COLUMNS	CUMULATIVE TOTAL
1	1	9744	2-13	1-48	
1	2	11959	2-13	1-48	
1	3	4264	2-13	1-48	21813
1	4	6020	2-13	1-48	
1	5	6984	2-13	1-48	10284
1	6	2310	2-14	1-48	6984
1	7	2310	2-14	1-48	
1	8	994	2-14	1-48	4020
1	9	994	2-14	1-48	
1	10	1248	2-14	1-48	1968
1	11	2739	2-37	1-48	1248
1	12	2332	2-37	1-48	
1	13	2716	2-37	1-48	5071
1	14	2332	2-37	1-48	
1	15	3350	2-37	1-48	5048
1	16	924	2-27	1-48	3960
1	17	1133	2-27	1-48	
1	18	964	2-27	1-48	2057
1	19	1172	2-27	1-48	
1	20	3192	2-27	1-48	2136
1	21	1920	2-47	1-48	3192
1	22	2156	2-47	1-48	
1	23	3128	2-47	1-48	4076
1	24	3358	2-47	1-48	
1	25	3900	2-47	1-48	7096
1	26	534	2-47	1-48	3900
1	27	726	2-47	1-48	
1	28	1494	2-47	1-48	1265
1	29	1424	2-47	1-48	
1	30	5496	2-47	1-48	2908
1	31	14	2-47	1-48	5496
1	32	0	2-47	1-48	
1	33	34	2-47	1-48	14
1	34	0	2-47	1-48	
1	35	24	2-47	1-48	34
1	36	0	1-42	1-48	24
1	37	0	1-42	1-48	
1	38	0	1-42	1-48	0
1	39	0	1-42	1-48	
1	40	0	1-42	1-48	0

TABLE 17

PIKESUNNEL NODES

Table 17 cont.

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TABLE 18

SUMMARY OF PERSONNEL FLOW DURING TIME PERIOD ONE

TOURIN	SUBIN	TOURKOUT	SUBOUT	N MEN IN	N LOST	N IN SYST	M IN TOUR (ROW)
1	1	5	1	124	36	17	1
1	1	5	1	126	34	16	1
1	1	5	1	129	31	15	1
1	1	5	1	132	28	14	1
1	1	5	1	135	25	13	1
1	1	5	1	138	22	12	1
1	1	5	1	141	19	11	1
1	1	5	1	143	17	12	1
1	2	5	2	177	19	17	1
1	2	5	2	179	17	16	1
1	2	5	2	181	15	15	1
1	2	5	2	182	14	14	1
1	2	5	2	184	12	13	1
1	2	5	2	185	11	12	1
1	2	5	2	187	9	11	1
1	5	5	5	294	31	13	1
1	5	5	5	297	28	12	1
1	5	5	5	299	26	11	1
1	5	5	5	301	24	10	1
1	5	5	5	304	21	9	1
1	5	5	5	306	19	8	1
1	5	5	5	309	16	7	1
1	5	5	5	311	14	6	1
1	5	7	5	2	0	13	1
5	1	0	1	4450	0	1	1
6	5	1	5	582	0	13	1
2	2	0	2	4450	0	1	1

input into column 17 and row 1 of the node 1,1 from node 5,1 and 36 men were lost to the system. This extensive printout is output for each time period simulated.

At the end of the GMM simulation, DISTRO distributes the tour area totals, less transients, to command elements. Table 10 shows the printout of the distribution for each tour area and 20 percent of the four time periods. To illustrate use of the model, look at tour area 4, time period 1. The 4620 nontransients minus a 20 percent patient rate, representing other nondeployability not specifically covered previously by the model, equals 3696 deployable personnel to be distributed to two command elements (defined in Table 7 as Thailand-StratCom and Korea). Eighty-five percent of the 79 and 4544 personnel authorizations, or 67 and 3862, equal the command element manning levels. Only 63 and 3633 personnel are allocated to these command elements, leaving a -233 Surplus, or Shortfall of 233 personnel. Each tour area distribution is output in the same manner.

Even though this example appears complicated, it simulates a MOS with a relatively simple structure and flow. Needless to say, other MOS groups could be much more complex. At this point the bulky output is not useful to management without summarization. Thus, once the types of output needed have been determined, special routines will be developed to output this information concisely.

DISTRIBUTION OF PERSONNEL FROM TOUR AREA TO COMMAND ELEMENTS

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Table 19 cont.

TOUR AREA	TOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
1	5402	.30	4481	1	1184 S1A	1.00	9096	9096	4481	-4615
2	5243	.30	5770	2	1184 S1A	1.00	9096	9096	5770	-3326
3	7474	.30	5581	3	1184 S1A	1.00	9096	9096	5581	-3515
4	7705	.30	5393	4	1184 S1A	1.00	9096	9096	5393	-3703
5	4520	.20	3696	1	1181 S2A	.85	79	67	63	-233
					1181 S2R	.85	4544	3862	3633	-173
6	4620	.20	3696	2	1181 S2A	.85	77	65	62	-448
					1181 S2R	.85	4475	3804	3634	-725
7	4200	.20	3360	3	1181 S2A	.85	76	65	57	-448
					1181 S2R	.85	4404	3743	3303	-725
8	1780	.20	3023	4	1181 S2A	.85	75	64	52	-448
					1181 S2R	.85	4334	3684	2971	-725
9	1958	.20	1574	1	1182 S2A	.85	78	66	62	-91
					1182 S2R	.85	1881	1599	1512	-65
10	1958	.20	1574	2	1182 S2A	.85	77	65	62	-40
					1182 S2R	.85	1852	1574	1512	-14
11	1958	.20	1574	3	1182 S2A	.85	76	65	63	-40
					1182 S2R	.85	1822	1549	1511	-14
12	1958	.20	1574	4	1182 S2A	.85	75	64	63	-14
					1182 S2R	.85	1793	1524	1511	-14
13	1238	.20	998	1	1184 S2A	.85	70	67	61	
					1184 S2R	.85	1175	974	911	

Table 19, cont.

Table 19 cont.										
			915	2	1184 SPA .85	78	66	58		-68
					1184 SPA .85	1156	983	857		-134
n	1040	.20	832	3	1184 SPA .85	89	76	53		
					1184 SPA .85	1726	1127	779		-311
n	436	.20	748	4	1184 SPA .85	75	64	47		
					1184 SPA .85	1121	953	701		-269
BOOK AREA	BOOK TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
		.10	4563	1	1181 LTA	.50	846	423	423	
					1181 LTR	.50	4222	2111	2111	2029
		.10	4563	2	1181 LTA	.50	800	430	430	
					1181 LTR	.50	4291	2146	2146	1987
		.10	4563	3	1181 LTA	.50	874	437	437	
					1181 LTR	.50	4259	2180	2180	1946
		.10	4563	4	1181 LTA	.50	888	444	444	
					1181 LTR	.50	4428	2214	2214	1905
BOOK AREA	BOOK TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
n	5048	.10	4543	1	1182 LTA	.50	983	492	492	
					1182 LTR	.50	4085	2043	2043	2008
n	5040	.10	4543	2	1182 LTA	.50	999	500	500	
					1182 LTR	.50	4152	2076	2076	1967
n	5048	.10	4543	3	1182 LTA	.50	1015	508	508	
					1182 LTR	.50	4218	2109	2109	1926
n	5040	.10	4543	4	1182 LTA	.50	1031	516	516	
					1182 LTR	.50	4285	2143	2143	1884
BOOK AREA	BOOK TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
n	3550	.10	3564	1	1184 LTA	.50	844	422	422	
					1184 LTR	.50	3098	1549	1549	1571

Table 19 cont.

Table 19 cont.										
					1184 LTA .50	857	429	429		
					1184 LTR .50	3149	1575	1575		1560
	1950	.10	3564	3	1184 LTA .50	871	436	436		
					1184 LTR .50	3199	1600	1600		1528
	1950	.10	3564	4	1184 LTA .50	885	443	443		
					1184 LTR .50	3249	1625	1625		1496
FOUR AREA	FOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
	2057	.05	1954	1	1181 SRA .40	2008	827	827		
					1181 SRA .40	0	0	0		1127
	2057	.05	1954	2	1181 SRA .40	2080	832	832		
					1181 SRA .40	0	0	0		1122
	2057	.05	1977	3	1181 SRA .40	2092	837	837		
					1181 SRA .40	0	0	0		1140
	2119	.05	2013	4	1181 SRA .40	2104	842	842		
					1181 SRA .40	0	0	0		1171
FOUR AREA	FOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
	2136	.05	2029	1	1182 SRA .40	74	30	30		
					1182 SRA .40	1994	798	798		1201
	2136	.05	2029	2	1182 SRA .40	75	30	30		
					1182 SRA .40	2005	802	802		1197
	2136	.05	2029	3	1182 SRA .40	75	30	30		
					1182 SRA .40	2017	807	807		1192
	2136	.05	2029	4	1182 SRA .40	76	30	30		
					1182 SRA .40	2028	811	811		1188
FOUR AREA	FOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
	3122	.05	3032	1	1184 SRA .40	1254	502	502		
					1184 SRA .40	1995	798	798		1732
	3122	.05	3032	2	1184 SRA .40	1261	504	504		
					1184 SRA .40	2002	801	801		

Table 19 cont.

Table 19 cont.										1725
12	3192	.05	3032	3	1104 SRA .40	1709	508	508		
					1104 SRA .40	2019	808	808		
12	3192	.05	3032	4	1104 SRA .40	1777	511	511		1716
					1104 SRA .40	2030	812	812		
TOUR AREA	TOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
12	1424	.02	1395	1	1101 C1A .30		31	9	9	
					1101 C1R .30		8	2	2	
					1101 C1C .30		23	7	7	
					1101 C1D .30		358	107	107	
					1101 C1F .30		270	81	81	
					1101 C1F .30		1404	421	421	
12	9958	.02	9768	2	1101 C1A .30		32	10	10	768
					1101 C1R .30		8	2	2	
					1101 C1C .30		23	7	7	
					1101 C1D .30		360	108	108	
					1101 C1F .30		271	81	81	
					1101 C1F .30		1409	423	423	
12	14512	.02	14141	3	1101 C1A .30		32	10	10	9137
					1101 C1R .30		8	2	2	
					1101 C1C .30		23	7	7	
					1101 C1D .30		361	108	108	
					1101 C1F .30		272	82	82	
					1101 C1F .30		1414	424	424	
12	24385	.02	22639	4	1101 C1A .30		32	10	10	17508
					1101 C1R .30		8	2	2	
					1101 C1C .30		23	7	7	
					1101 C1D .30		362	109	109	
					1101 C1F .30		273	82	82	
					1101 C1F .30		1420	426	426	
TOUR AREA	TOUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
14	7070	.02	6954	1	1102 C1A .30		128	38	38	22203
					1102 C1R .30		8	2	2	
					1102 C1C .30		8	2	2	
					1102 C1D .30		3246	974	974	
					1102 C1F .30		315	95	95	
					1102 C1F .30		44	15	15	
14	5322	.02	5215	2	1102 C1A .30		128	38	38	5828
					1102 C1R .30		8	2	2	
					1102 C1C .30		8	2	2	
					1102 C1D .30		128	38	38	

Table 19 cont.

					1182 C1F .30	316	95	95	
					1182 C1F .30	49	15	15	
									4086
14	3548	.02	3477	3	1182 C1A .30	129	39	39	
					1182 C1A .30	8	2	2	
					1182 C1C .30	8	2	2	
					1182 C1D .30	3271	981	981	
					1182 C1F .30	414	95	95	
					1182 C1F .30	49	15	15	
									2343
14	1774	.02	1738	4	1182 C1A .30	129	39	39	
					1182 C1A .30	8	2	2	
					1182 C1C .30	8	2	2	
					1182 C1D .30	3284	985	985	
					1182 C1F .30	414	96	96	
					1182 C1F .30	49	15	15	
									594
1000	1000	PATIENT	DEPLOYABLE	TIME					
1000	1000	RATE		PERIOD					
					COMMAND	FILL	COMMAND	COMMAND	AREA
					ELEMENT	RATE	AUTH	FILL	ALLOCATION
15	1580	.02	1274	1	1184 C1A .30	40	12	12	
					1184 C1A .30	8	2	2	
					1184 C1C .30	8	2	2	
					1184 C1D .30	357	107	107	
					1184 C1F .30	104	31	31	
					1184 C1F .30	1509	471	471	
									649
15	1774	.02	955	2	1184 C1A .30	40	12	12	
					1184 C1A .30	8	2	2	
					1184 C1C .30	8	2	2	
					1184 C1D .30	358	107	107	
					1184 C1F .30	105	32	32	
					1184 C1F .30	1575	473	473	
									327
15	550	.02	637	3	1184 C1A .30	40	12	12	
					1184 C1A .30	8	2	2	
					1184 C1C .30	8	2	2	
					1184 C1D .30	360	108	108	
					1184 C1F .30	105	32	32	
					1184 C1F .30	1481	474	474	
									1
15	325	.02	318	4	1184 C1A .30	40	12	6	
					1184 C1A .30	8	2	1	
					1184 C1C .30	8	2	1	
					1184 C1D .30	361	108	54	
					1184 C1F .30	106	32	16	
					1184 C1F .30	1487	476	240	
									-314
1000	1000	PATIENT	DEPLOYABLE	TIME					
1000	1000	RATE		PERIOD					
					COMMAND	FILL	COMMAND	COMMAND	AREA
					ELEMENT	RATE	AUTH	FILL	ALLOCATION
16	1255	.01	1252	1	1181 C1A .30	12	2	2	
					1181 C1A .30	1	1	1	

Table 19 cont.

					1181	C2C	.20	6	1	1	
					1181	C2D	.20	154	32	32	
					1181	C2F	.20	116	23	23	
					1181	C2F	.20	614	123	123	
16	1255	.01	1252	2							1070
					1181	C2A	.20	12	2	2	
					1181	C2H	.20	6	1	1	
					1181	C2C	.20	6	1	1	
					1181	C2D	.20	158	32	32	
					1181	C2F	.20	116	23	23	
					1181	C2F	.20	616	123	123	
16	5015	.01	2984	3							1070
					1181	C2A	.20	12	2	2	
					1181	C2H	.20	6	1	1	
					1181	C2C	.20	6	1	1	
					1181	C2D	.20	159	32	32	
					1181	C2F	.20	117	23	23	
					1181	C2F	.20	618	124	124	
16	5129	.01	5107	4							2801
					1181	C2A	.20	12	2	2	
					1181	C2H	.20	6	1	1	
					1181	C2C	.20	6	1	1	
					1181	C2D	.20	159	32	32	
					1181	C2F	.20	117	23	23	
					1181	C2F	.20	620	124	124	
											4924
TOUR	TOUR	PATIENT	DEPLOYABLE	TIME							
AREA	DATE	DATE	PERIOD		COMMAND	FILL	COMMAND	COMMAND	COMMAND	AREA	
					ELEMENT	RATE	AUTH	FILL	ALLOCATION	SURPLUS	
17	2908	.01	2878	1							
					1182	C2A	.20	55	11	11	
					1182	C2H	.20	7	1	1	
					1182	C2C	.20	7	1	1	
					1182	C2D	.20	1448	286	286	
					1182	C2F	.20	139	28	28	
					1182	C2F	.20	37	7	7	
17	2908	.01	2878	2							2544
					1182	C2A	.20	55	11	11	
					1182	C2H	.20	7	1	1	
					1182	C2C	.20	7	1	1	
					1182	C2D	.20	1432	286	286	
					1182	C2F	.20	139	28	28	
					1182	C2F	.20	37	7	7	
17	2908	.01	2878	3							2544
					1182	C2A	.20	56	11	11	
					1182	C2H	.20	7	1	1	
					1182	C2C	.20	7	1	1	
					1182	C2D	.20	1437	287	287	
					1182	C2F	.20	140	28	28	
					1182	C2F	.20	37	7	7	
17	2908	.01	2878	4							2543
					1182	C2A	.20	56	11	11	
					1182	C2H	.20	7	1	1	
					1182	C2C	.20	7	1	1	
					1182	C2D	.20	1437	287	287	

Table 19, cont.

Table 19. cont.										
				1182 C2F .20		140	24	24		
				1182 C2F .20		37	7	7		
2542										
TOUR AREA	TJUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
14	5470	.01	5441	1	1184 C2A	.20	73	15	15	4742
					1184 C2B	.20	7	1	1	
					1184 C2C	.20	10	2	2	
					1184 C2D	.20	601	120	120	
					1184 C2E	.20	171	34	34	
					1184 C2F	.20	2633	527	527	
18	5070	.01	6017	2	1184 C2A	.20	74	15	15	5310
					1184 C2B	.20	7	1	1	
					1184 C2C	.20	11	2	2	
					1184 C2D	.20	603	121	121	
					1184 C2E	.20	172	34	34	
					1184 C2F	.20	2641	528	528	
18	4750	.01	6696	3	1184 C2A	.20	74	15	15	5923
					1184 C2B	.20	7	1	1	
					1184 C2C	.20	11	2	2	
					1184 C2D	.20	605	121	121	
					1184 C2E	.20	172	34	34	
					1184 C2F	.20	2649	530	530	
18	7400	.01	7315	4	1184 C2A	.20	74	15	15	6670
					1184 C2B	.20	7	1	1	
					1184 C2C	.20	11	2	2	
					1184 C2D	.20	607	121	121	
					1184 C2E	.20	173	35	35	
					1184 C2F	.20	2657	531	531	
TOUR AREA	TJUR TOTAL	PATIENT RATE	DEPLOYABLE	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
19	14	0	14	1	1181 C2A	.10	0	0	0	-12
					1181 C2B	.10	0	0	0	
					1181 C2C	.10	0	0	0	
					1181 C2D	.10	45	5	3	
					1181 C2E	.10	30	3	2	
					1181 C2F	.10	182	18	10	
19	14	0	14	2	1181 C2A	.10	0	0	0	-12
					1181 C2B	.10	0	0	0	
					1181 C2C	.10	0	0	0	
					1181 C2D	.10	45	5	3	
					1181 C2E	.10	30	3	2	
					1181 C2F	.10	181	18	10	
19	14	0	14	3	1181 C2A	.10	0	0	0	
					1181 C2B	.10	0	0	0	

Table 19 cont.

Table 19 cont.				1101 C3C	.10	0	0	0		
				1101 C3D	.10	45	5	3		
				1101 C3F	.10	30	3	2		
				1101 C3F	.10	181	18	10	-12	
19	14	0	14	4						
				1101 C3A	.10	0	0	0		
				1101 C3A	.10	0	0	0		
				1101 C3C	.10	44	4	2		
				1101 C3D	.10	44	4	2		
				1101 C3F	.10	179	18	10		
				1101 C3F	.10	0	0	0	-12	
FOUR AREA	FOUR TOTAL	PATIENT RATE	DEPLOYABLE PERIOD	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
20	34	0	34	1						
				1102 C3A	.10	15	2	1		
				1102 C3A	.10	0	0	0		
				1102 C3C	.10	0	0	0		
				1102 C3D	.10	426	43	24		
				1102 C3F	.10	45	5	3		
				1102 C3F	.10	15	2	1	-16	
20	34	0	34	2						
				1102 C3A	.10	15	2	1		
				1102 C3A	.10	0	0	0		
				1102 C3C	.10	0	0	0		
				1102 C3D	.10	423	42	24		
				1102 C3F	.10	45	5	3		
				1102 C3F	.10	15	2	1	-17	
20	34	0	34	3						
				1102 C3A	.10	15	2	1		
				1102 C3A	.10	0	0	0		
				1102 C3C	.10	0	0	0		
				1102 C3D	.10	421	42	24		
				1102 C3F	.10	45	5	3		
				1102 C3F	.10	15	2	1	-17	
20	34	0	34	4						
				1102 C3A	.10	15	2	1		
				1102 C3A	.10	0	0	0		
				1102 C3C	.10	0	0	0		
				1102 C3D	.10	419	42	24		
				1102 C3F	.10	44	4	3		
				1102 C3F	.10	15	2	1	-16	
FOUR AREA	FOUR TOTAL	PATIENT RATE	DEPLOYABLE PERIOD	TIME PERIOD	COMMAND ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	AREA SURPLUS
21	22	0	22	1						
				1104 C3A	.10	0	0	0		
				1104 C3A	.10	0	0	0		
				1104 C3C	.10	0	0	0		
				1104 C3D	.10	0	0	0		
				1104 C3F	.10	15	2	2		
				1104 C3F	.10	228	23	20	-1	

Table 19 cont.

					1184 C3A	.10	0	0	0	
					1184 C3B	.10	0	0	0	
					1184 C3C	.10	0	0	0	
					1184 C3D	.10	0	0	0	
					1184 C3E	.10	15	2	2	
					1184 C3F	.10	227	23	18	-5
21	18	0	19	3						
					1184 C3A	.10	0	0	0	
					1184 C3B	.10	0	0	0	
					1184 C3C	.10	0	0	0	
					1184 C3D	.10	0	0	0	
					1184 C3E	.10	15	2	1	
					1184 C3F	.10	226	23	17	-1
21	18	0	16	4						
					1184 C3A	.10	0	0	0	
					1184 C3B	.10	0	0	0	
					1184 C3C	.10	0	0	0	
					1184 C3D	.10	0	0	0	
					1184 C3E	.10	15	2	1	
					1184 C3F	.10	225	23	15	-9
1000	1000	PATIENT	DEPLOYABLE	TIME						
AREA	AREA	AREA	PERIOD							
					COMMAND	FILL	COMMAND	COMMAND	COMMAND	AREA
					ELEMENT	RATE	AUTH	FILL	ALLOCATION	SURPLUS
22	0	0	0	1						
					1181 C4A	.30	0	0	0	
					1181 C4B	.30	0	0	0	
					1181 C4C	.30	0	0	0	
					1181 C4D	.30	0	0	0	
					1181 C4E	.30	0	0	0	
					1181 C4F	.30	0	0	0	0
22	0	0	0	2						
					1181 C4A	.30	0	0	0	
					1181 C4B	.30	0	0	0	
					1181 C4C	.30	0	0	0	
					1181 C4D	.30	0	0	0	
					1181 C4E	.30	0	0	0	
					1181 C4F	.30	0	0	0	0
22	0	0	0	3						
					1181 C4A	.30	0	0	0	
					1181 C4B	.30	0	0	0	
					1181 C4C	.30	0	0	0	
					1181 C4D	.30	0	0	0	
					1181 C4E	.30	0	0	0	
					1181 C4F	.30	0	0	0	0
22	0	0	0	4						
					1181 C4A	.30	0	0	0	
					1181 C4B	.30	0	0	0	
					1181 C4C	.30	0	0	0	
					1181 C4D	.30	0	0	0	
					1181 C4E	.30	0	0	0	
					1181 C4F	.30	0	0	0	0
1000	1000	PATIENT	DEPLOYABLE	TIME						
AREA	AREA	AREA	PERIOD							
					COMMAND	FILL	COMMAND	COMMAND	COMMAND	AREA
					ELEMENT	RATE	AUTH	FILL	ALLOCATION	SURPLUS

Table 19 cont.

TOUR AREA	TOUR TOTAL	PATIENT RATE	DEPLOYABLE PERIOD	TIME PERIOD	COMMAND					AREA SURPLUS
					ELEMENT	FILL RATE	COMMAND AUTH	COMMAND FILL	COMMAND ALLOCATION	
23	0	0	0	2	1142 C4A	.30	0	0	0	0
					1142 C4R	.30	0	0	0	
					1142 C4C	.30	0	0	0	
					1142 C4D	.30	0	0	0	
					1142 C4E	.30	0	0	0	
					1142 C4F	.30	0	0	0	
23	0	0	0	3	1142 C4A	.30	0	0	0	0
					1142 C4R	.30	0	0	0	
					1142 C4C	.30	0	0	0	
					1142 C4D	.30	0	0	0	
					1142 C4E	.30	0	0	0	
					1142 C4F	.30	0	0	0	
23	0	0	0	4	1142 C4A	.30	0	0	0	0
					1142 C4R	.30	0	0	0	
					1142 C4C	.30	0	0	0	
					1142 C4D	.30	0	0	0	
					1142 C4E	.30	0	0	0	
					1142 C4F	.30	0	0	0	
24	0	0	0	1	1144 C4A	.30	0	0	0	0
					1144 C4R	.30	0	0	0	
					1144 C4C	.30	0	0	0	
					1144 C4D	.30	0	0	0	
					1144 C4E	.30	0	0	0	
					1144 C4F	.30	0	0	0	
24	0	0	0	2	1144 C4A	.30	0	0	0	0
					1144 C4R	.30	0	0	0	
					1144 C4C	.30	0	0	0	
					1144 C4D	.30	0	0	0	
					1144 C4E	.30	0	0	0	
					1144 C4F	.30	0	0	0	
24	0	0	0	3	1144 C4A	.30	0	0	0	0
					1144 C4R	.30	0	0	0	
					1144 C4C	.30	0	0	0	
					1144 C4D	.30	0	0	0	
					1144 C4E	.30	0	0	0	
					1144 C4F	.30	0	0	0	
24	0	0	0	4	1144 C4A	.30	0	0	0	0
					1144 C4R	.30	0	0	0	
					1144 C4C	.30	0	0	0	
					1144 C4D	.30	0	0	0	
					1144 C4E	.30	0	0	0	
					1144 C4F	.30	0	0	0	

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APPENDIX

COMPUTER LISTINGS OF DISTRO SUBROUTINES

SUBROUTINE DISTR0(MAT0UT,MATIN)
FEBRUARY 1969-PROGRAMMER WITT

DISTRIBUTION SUBROUTINE-DISTRIBUTES AVAILABLE ASSETS IN EACH TIME
PERIOD AMONG SPECIFIC COMMAND ELEMENTS

```

COMMON      NOFIRST ,NOLAST ,NOTT ,ITRTIME ,INTEG
COMMON      IP ,INE(48) ,IFND ,OUTTT(200)
COMMON      OUTST(200),OUTTO(200) ,OUTSO(200)
COMMON      PCT(200) ,PERD(200),JK ,SYST(48,48)
COMMON      PA(100) ,NAV(100) ,LFNGTH(100) ,OUT(100)
COMMON      INTOUR(220) ,INSUB(220) ,OUTTOUR(220)
COMMON      IOD(220) ,OUTSUB(220) ,AFTER(220)
COMMON      PER(220) ,RATE(100) ,NEEDS(10),NE(10,10)
COMMON      IOS(10) ,NED(10) ,NFE(100) ,IFILL ,MAXLEN
COMMON      NTOUR ,NP ,CIOS ,PERDIO(200)
COMMON      PDW ,LSTRSTO(10) ,LSTRSTT(10)
COMMON      LSTRSTS(10) ,ITT ,MAXSUB ,ACT(10)
COMMON      NSIT(10) ,INOS(10,10) ,IGRADE(220)
COMMON      REP(220) ,ITYPF(220) ,PEROUT(220)
COMMON      IDISTON ,ISUM ,GRPSUM(100) ,PRIO(100)
COMMON      BEGROW(100) ,ENDROW(100) ,BEGCOL(100)
COMMON      ENDCOL(100) ,MATSUM(100) ,MATGRPS(100)
COMMON      TYPE(100),SUB(100) ,NUM(100) ,ACTUAL(100)
COMMON      NPRLEV ,NT ,IHOLD ,LEN ,LEVEL ,M
COMMON      NCRNODE(100) ,MTN(100) ,GRPINPR(100)
COMMON      MAXDEPL(100)
INTEGER      TYPE ,SUB ,ACTUAL ,ENDCOL ,GRPINPR
INTEGER      CIOS ,SYST ,OUTSUB ,OUTTOUR ,AFTER
INTEGER      ACT ,OUTTO ,OUTSO ,OUTTT ,OUTST
INTEGER      PERD ,GRPSUM ,BEGROW ,ENDROW ,BEGCOL
INTEGER      PERDIO

```

SUBROUTINE PARAMETERS

NPRLEV=NUMBER OF PRIORITY OF FILL LEVELS
 PRIO = PERCENTAGE OF FILL FOR NODE OR NODE CLUSTER
 GRPINPR(ISUM)=GROUP SUMS WITHIN PRIORITIES. INITIAL GROUP SUM=0 IN EACH
 PRIORITY. THE NUMBER OF PRIORITIES = NUMBER OF n.
 NCRNODE(ITT)=VECTOR OF CRITICAL NODES. WHICH MUST BE FILLED TO INITIAL
 LEVEL REGARDLESS OF OTHER LOWER PRIORITY NODE DEMANDS.
 NUMELEM=NUMBER OF ELEMENTS IN MATGRPS VECTOR
 MATGRPS=VECTOR DETERMINING WHICH MATRICES OR VECTORS ARE TO BE SUMMED
 AND WHICH AGGREGATE SUMS ARE TO BE OBTAINED
 NUMMAT=ACTUAL NUMBER OF MATRICES OR VECTORS SUMMED INDIVIDUALLY
 BEGROW,ENDROW,BEGCOL,AND ENDCOL=VECTORS OF NUMMAT ELEMENTS WHICH
 DETERMINE RESPECTIVE ROW AND COL BOUNDARIES FOR MATRIX SUMS
 IHOLD=NUMBER WHICH MUST REMAIN IN TOUR AREA TO MAINTAIN MINIMUM LEVEL
 OF FILL
 MAXDEPL(ISUM)=MAXIMUM DEPLOYABLE PERSONNEL WITHIN PRIORITY GROUP=
 TOTAL IN PRIORITY GROUP-TRANSIENTS.

SECTION 1

INPUT DISTRIBUTION PARAMETERS

ENTRY INPUT

READ 102,NPRLEV,ISUM

DO 18 I=1,NPRLEV

ISTART=I*NT-NT+1

ISTOP=I*NT

18 READ 101,(PRIO(J),J=ISTART,ISTOP)

```

INPR=ISUM+NT
READ 102,(GRPINPR(I),I=1,INPR)
READ 102,(NCRNODE(I),I=1,NT)
RFAD 102,NUMELEM,NUMMAT
READ 102,(MATGRPS(I),I=1,NUMELEM)
READ 102,(BEGROW(I),ENDROW(I),BEGCOL(I),ENDCOL(I),I=1,NUMMAT)

C
PRINT 103
PRINT 105
PRINT 106
J=0
DO 16 I=1,NUMELEM
IF (MATGRPS(I).EQ.0) GO TO 14
J=J+1
PRINT 109,MATGRPS(I),BEGROW(J),ENDROW(J),BEGCOL(J),ENDCOL(J)
GO TO 16
14 PRINT 110
16 CONTINUE
PRINT 104,(J,PRI0(J),J=1,ISTOP)
RETURN

C
C SECTION 2
C CALLS SUBROUTINE SUMMARY WHICH OBTAINS TOTALS
C ENTRY ISUMAR
INDIV=INTOT=0
CALL SUMMARY(NUMELEM,INDIV,INTOT)
C CALCULATE MAXIMUM DEPLOYABLE AVAILABLE IN TOUR AREA
J=0
ISUM1=J=0
DO 21 I=1,INPR
IF (GRPINPR(I).GT.0) GO TO 17
J=J+1
MAXDEPL(J)=0
GO TO 21
17 ISUM1=ISUM1+1
MAXDEPL(J)=MAXDEPL(J)+GRPSUM(ISUM1)
21 CONTINUE
PRINT 117,ISUM1,J
RETURN

C
C SECTION 3
C MODIFICATION OF REQUIREMENTS FOR TIME PERIOD
C ENTRY MODIFY
J=LEVEL*NT-NT
DO 6 I=1,NT
MIN(I)=0
J=J+1
IF (IFILL-1) 9,10
9 NEEDS(I)=NED(I)*PRI0(J)-ACT(I)
IF (NEEDS(I)) 3,4,4
3 NEEDS(I)=0
GO TO 4
10 NE(I)=NEE(I)*PRI0(I)-ACTUAL(I)
IF (NE(I)) 11,4,4
11 NE(I)=0
4 IF (MAXDEPL(I).LT.NEEDS(I)) MIN(I)=1
6 CONTINUE
IF (IFILL-1) 12,13
12 PRINT 107,(I,NEEDS(I),I=1,NT)
PRINT 112,(NED(I),I=1,NT)
PRINT 113,(ACT(I),I=1,NT)
ISTART=LEVEL*NT-NT+1

```

```

      ISTOP=LEVEL*NT
      PRINT 114,LEVEL,(PRIO(I),I=ISTART,ISTOP)
      PRINT 115,(NCRNODE(I),I=1,NT)
      PRINT 116,(GRPINPR(I),I=1,INPR)
      GO TO 5
13  PRINT 108,(I,NE(I),I=1,NT)
      5  CONTINUE
      RETURN
C
C      SECTION 4
C      CALLS SUBROUTINE ADDUP WHICH DISTRIBUTES NODE CLUSTERS AMONG
C      SPECIFIC DISTRIBUTION AREAS.
      ENTRY IADD
      CALL ALLOCATE
      RETURN
C
C      SECTION 5
C      MAINTAINS MINIMUM LEVEL IN TOUR AREAS
      ENTRY MINIMUM
      IDEMAND=NFEDS(MATOUT)
      IF(NCRNODE(MATIN).EQ. 1) GO TO 25
      IF(MAXDEPL(MATOUT).LE.IDEMAND) GO TO 20
      IF((MAXDEPL(MATOUT)-SYST(M,LEN)).GE.IDEMAND) GO TO 25
      IOVER=MAXDEPL(MATOUT)-IDEMAND
      IHOLD=SYST(M,LEN)-IOVER
      SYST(M,LEN)=IOVER
      GO TO 25
20  IHOLD=SYST(M,LEN)
      SYST(M,LEN)=0
      MIN(MATOUT)=1
25  CONTINUE
      RETURN
C
C      SUBROUTINE DISTR FORMATS
101  FORMAT(8F10.4)
102  FORMAT(40I2)
103  FORMAT(24H0DISTRIBUTION PARAMETERS/)
104  FORMAT(13H0NODE CLUSTER,5X,9HFILL RATE/(18,10X, F5.3)/)
105  FORMAT(/40H0NONDEPLOYABLES AT BEGINNING AND END OF /30H0MATRICES W
      1ITHIN NODE CLUSTERS)
106  FORMAT(7H0MATRIX,2X,9HFIRST ROW,2X,8HLAST ROW,2X,9HFIRST COL,2X,8H
      1LAST COL)
107  FORMAT(/33H0MODIFIED NEEDS FOR NODE CLUSTERS/13H0NODE CLUSTER,3X,5
      1HNEEDS/(17,9X,I5))
108  FORMAT(/25H0MODIFIED NEEDS FOR NODES/5H0NODE,3X,5HNFEDS/(15,3X,I5)
      1)
109  FORMAT(15,4X,I6,5X,I5,4X,I6,5X,I5)
110  FORMAT(/)
112  FORMAT(7H0NEC = ,10I8)
113  FORMAT(7H0ACT = ,10I8)
114  FORMAT(7H0LEVEL ,13,/(8H0PRIO = ,10F5.3))
115  FORMAT(60H0CRITICAL NODE VECTOR. 1 = A CRITICAL NODE, 0 = NONCRIT
      1ICAL/(20I3))
116  FORMAT(37H0TOUR AREAS WITHIN PRIORITY GROUPS = /(20I3))
117  FORMAT(9H0ISUM1 = ,15,4HJ = ,14)
C
      END

```

FORTRAN DIAGNOSTIC RESULTS FOR DISTR0

```

SUBROUTINE ALLOCATE
COMMON      NOFIRST      ,NOLAST      ,NOUTT      ,ITRTIME ,INTEG
COMMON      IP           ,INE(48)    ,IFND       ,OUTTT(200)
COMMON      OUTST(200) ,OUTTO(200)   ,OUTSO(200)
COMMON      PCT(200)   ,PERD(200) ,JK         ,SYST(48,48)
COMMON      PA(100)    ,NAV(100)   ,LNGTH(100)   ,OUT(100)
COMMON      INTOUR(220) ,INSUB(220) ,OUTTOUR(220)
COMMON      IOD(220)   ,OUTSUB(220)   ,AFTER(220)
COMMON      PER(220)   ,RATE(100)    ,NEEDS(10) ,NE(10,10)
COMMON      IOS(10)    ,NED(10)    ,NFE(100)   ,IFILL   ,MAXLEN
COMMON      NTOUR      ,NP         ,CIOS       ,PERDIO(200)
COMMON      PDW        ,LSTRSTO(10) ,LSTRSTT(10)
COMMON      LSTRSTS(10) ,ITT        ,MAXSUB    ,ACT(10)
COMMON      NSIT(10)   ,INOS(10,10) ,IGRADE(220)
COMMON      REP(220)   ,ITYPE(220)   ,PEROUT(220)
COMMON      IDISTON    ,ISUM        ,GRPSUM(100)   ,PRIO(100)
COMMON      BEGROW(100) ,ENDROW(100) ,BEGCOL(100)
COMMON      ENDCOL(100) ,MATSUM(100) ,MATGRPS(100)
COMMON      TYPE(100) ,SUB(100)    ,NIM(100) ,ACTUAL(100)
COMMON      NPRLEV     ,NT         ,IHOLD    ,LEN      ,LEVEL   ,M
COMMON      NCRNODE(100) ,MTN(100) ,GRPINPR(100)
COMMON      MAXDEPL(100)
C
C      FOLLOWING COMMON STATEMENTS USED ONLY IN ALLOCATE
COMMON      NACTDEP(100) ,NAURATE(100)   ,IDNC(100)
COMMON      IDNC1(100)   ,NAUCAT(100)
INTEGER      TYPE        ,SUB
INTEGER      CIOS        ,SYST
INTEGER      ACT         ,OUTSUB
INTEGER      ACT         ,OUTTO
INTEGER      PERD        ,GRPSUM
INTEGER      DEPLOY      ,SURPLUS
INTEGER      PERDIO      ,TOTAUTH

```

SUBROUTINE ALLOCATE DISTRIBUTES RESOURCES AMONG COMMAND ELEMENTS WITHIN
TOUR AREAS.

DEFINITION OF VARIABLES

ISUM=NUMBER OF GROUPS OR TOUR AREAS TO BE DISTRIBUTED
 NCAT=NUMBER OF COMMAND ELEMENTS TO WHICH A TOUR AREA IS DISTRIBUTED
 IDNC=IDENTIFICATION FOR COMMAND ELEMENTS WITHIN TOUR AREAS
 RATE=RATE OF FILL FOR COMMAND ELEMENTS.
 DEPLOY=NUMBER OF DEPLOYABLE PERSONNEL WITHIN A TOUR AREA
 PA=PATIENT RATE FOR EACH TOUR AREA
 NAUCAT(NCAT)=AUTHORIZATION FOR EACH COMMAND ELEMENT
 NAURATE(NCAT)=PERSONNEL AUTHORIZED*RATE OF FILL FOR EACH COMMAND ELEMENT
 NACTDEP(NCAT)=NUMBER ACTUALLY DEPLOYED OR ASSIGNED TO A COMMAND ELEMENT
 FOR A TIME PERIOD
 TOTAUTH(ISUM)=TOTAL AUTHORIZATIONS*FILL RATES FOR TOUR AREAS.
 SURPLUS=UNASSIGNED DEPLOYABLE PERSONNEL

```

PRINT 103
INTEG=INTFG-1
READ 101, (PA(I), I=1, ISUM)

```

```

DO 20 I=1, ISUM
PRINT 105
READ 102, NCAT, (IDNC(J), IDNC1(J), J=1, NCAT)
READ 101, (RATE(J), J=1, NCAT)

```

```

DO 20 K=1,INTEG
  RFAD 100,(NAUCAT(J),J=1,NCAT)
C   DETERMINES DEPLOYABLE PERSONNEL FOR EACH TOUR AREA
  PRINT 109
  CALL RANRFAD(14,GRPSUM,ISUM,K)
  DFLOY=GRPSUM(I)*(1-PA(I))
  PRINT 106,I,GRPSUM(I),PA(I),DEPLOY,K
  TOTAUTH=0
C
C   DETERMINES PERCENT OF AUTHORIZATIONS WHICH MAY BE FILLED
  DO 5 J=1,NCAT
    NAURATE(J)=NAUCAT(J)*RATE(J) + .5
  5 TOTAUTH=TOTAUTH+NAURATE(J)
C
  X1=DEPLOY
  X2=TOTAUTH
  XINTER=X1/X2
C
  DO 40 J=1,NCAT
    IF(DEPLOY.GT. TOTAUTH) GO TO 15
    NACTDEP(J)=XINTER*NAURATE(J)+.5
    GO TO 40
  15 NACTDEP(J)=NAURATE(J)
  40 PRINT 107,IDNC(J),IDNC1(J),RATE(J),NAUCAT(J),NAURATE(J),NACTDEP(J)
C
  SURPLUS=DFLOY-TOTAUTH
  20 PRINT 108,SURPLUS
C
C
C   FORMATS
  100 FORMAT(8I10)
  101 FORMAT(16F5.4)
  102 FORMAT(15,(10(A4,A3)))
  103 FORMAT(/14H0DISTRIBUTIONS)
  105 FORMAT(1X,4HTOUR,3X,4HTOUR,2X,7HPATIENT,2X,10HDEPLOYABLE,3X,4HTIME
    1/1X,4HAREA,2X,5HTOTAL,3X,4HRAVE,16X,6HPERIOD/43X,7HCOMMAND,2X,4HFI
    2LL,2X,7HCOMMAND,2X,7HCOMMAND,2X,7HCOMMAND,7X,4HAREA/43X,7HELEMENT,
    32X,4HRAVE,3X,4HAUTH,4X,7H FILL,2X,10HALLOCATION,2X,7HSURPLUS)
  106 FORMAT(14,I8,F7.2,I12,I8)
  107 FORMAT(42X,A4,1X,A3,F5.2,I9,I9,I9)
  108 FORMAT(87X,I7)
  109 FORMAT(1H*)
  RETURN
  END

```

FORTRAN DIAGNOSTIC RESULTS FOR ALLOCATE

NO ERRORS